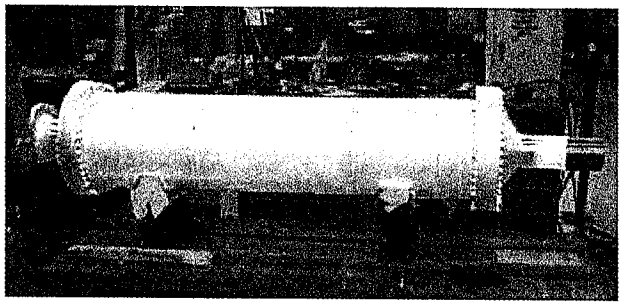
NOVEMBER 2003



LM2500 HIGH SPEED COUPLING SHAFT REFURBISHMENT PROCEDURE

PREPARED BY

CODE 9333 - PROPULSION GAS TURBINES

Attachment 1

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A. SAFETY PRECAUTIONS

A.1 General Safety Precautions

The following are general safety precautions that are not related to any specific procedures and therefore, do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

A.1.1 Toxics

Use all cleaning solvents, fuels, oils, adhesives, and epoxies and catalysts in a well-ventilated area. Avoid frequent and prolonged inhalation of fumes. Concentrations of fumes of many cleaners, adhesives and esters are toxic and will cause serious deterioration of the body nervous systems and possible death, if breathed frequently. Avoid frequent or prolonged exposure to the skin. Wash thoroughly with soap and warm water as soon as possible after completing use of such materials. Take special precautions to prevent materials from entering the eyes. If exposed, rinse the eyes in an eye bath fountain immediately and report to a physician.

A.1.2 Adhesives

Do not allow adhesives to contact the skin. Rapid bonding of certain adhesives will cause instant adhesion to the body members or objects. Do not attempt to forcefully separate body members if bonded together. Consult the area supervisor or physician for procedures for separation.

A.1.3 Flammables

Keep all cleaning solvents, oils, esters and adhesives away from open flame space heaters, exposed element electric heaters, sparks or flame. Do not smoke when using; or are in the vicinity of flammable materials, or in areas where flammables are stored. Provide adequate ventilation to disperse vapors. Provide approved containers for bulk storage of flammable materials, and for dispensers in the working areas. Keep all containers tightly closed when not in use.

A.1.4 Compressed Air

Air pressure, used in work areas for cleaning or drying operations, shall be regulated to 29 psi or less. Use approved safety equipment (goggles/face shield) to prevent injury to the eyes. Do not direct the jet of compressed air at self or other personnel; or so that refuse is blown onto adjacent workstations. If additional air pressure is required to dislodge foreign materials from parts, ensure that approved safety equipment is worn, and move to an isolated area. Be sure that the increased air pressure is not detrimental or damaging to the parts before applying high-pressured jets of air.

A.1.5 Heat and Cold

Used approved thermally insulated gloves when handling either heated or chilled parts, to prevent burns or freezing of hands. Parts chilled to super-cold (-40 to –65 degrees F) temperatures can cause instant freezing of hands if parts are handled without protective gloves. Adequate precautions should be taken to prevent operating personnel from inadvertently coming in contact with the hot surfaces.

A.1.6 Maintenance and Procedures

Wear safety glasses or other appropriate eye protection at all times. Do not allow safety wire or wire clippings to fly from the cutter when removing or installing wire. Do not use fingers as guides when installing parts or to check alignment of holes. Use only correct tools and fixtures, and use as recommended. Avoid short cuts, such as using less than recommended attaching bolts, shorter, or the incorrect quality of bolts. Heed all warnings in the manual text to avoid injury to personnel or damage to equipment.

A.1.7 Tooling

Improperly maintained tools and supporting equipment can be dangerous to personnel and can damage parts. Observe recommended inspections and schedules for inspection to avoid unanticipated failures. Use tooling only for the purpose for which it was designed, and avoid abuse. Be constantly alert for damaged equipment and initiate appropriate action for approved repair immediately.

A.2 Safety Summary

A.2.1 CAUTIONS:

1. When removing D-headed bolts from forward and aft flex couplings, caution should be taken not to over spread profile. Expand only wide enough to remove 4 bolts at time.

A.2.2 WARNINGS:

2. When installing Aft end Diaphragm/Dampener Assembly onto tube side "A", be sure to support distance piece at both ends, as it may become top heavy. (See section E.5 – Final Assembly)

B. REQUIRED TOOLING

The following list identifies refurbishment procedures that may require special tooling:

B.1 Damper Assembly
Assembly of Damper Plug
(See Section E.1.3)

B.2 Final Assembly Balance
Rigidize Diaphragm Assembly during Component Balance
(See Section E.5)

B.3 Forward End Sub Assembly Balance
Spread Diaphragm during Flex Coupling Balance
(See Section E.3)

B.4 Diaphragm Bolt Installation
Spread Diaphragm for Removal and Replacement of D-headed Bolts
(See Section E.2.2)

C. DISASSEMBLY

CAUTION: Handle flexible couplings (Items 2 and 25) with care, as any damage can render these parts unusable.

Note: Reference *Figure 1-High Speed Coupling Shaft Assembly* for item number identification.
Reference *Table 1-High Speed Coupling Shaft Parts List* for item descriptions.
Reference *Figure 2-Match Mark Assembly* for typical match marking of coupling components.

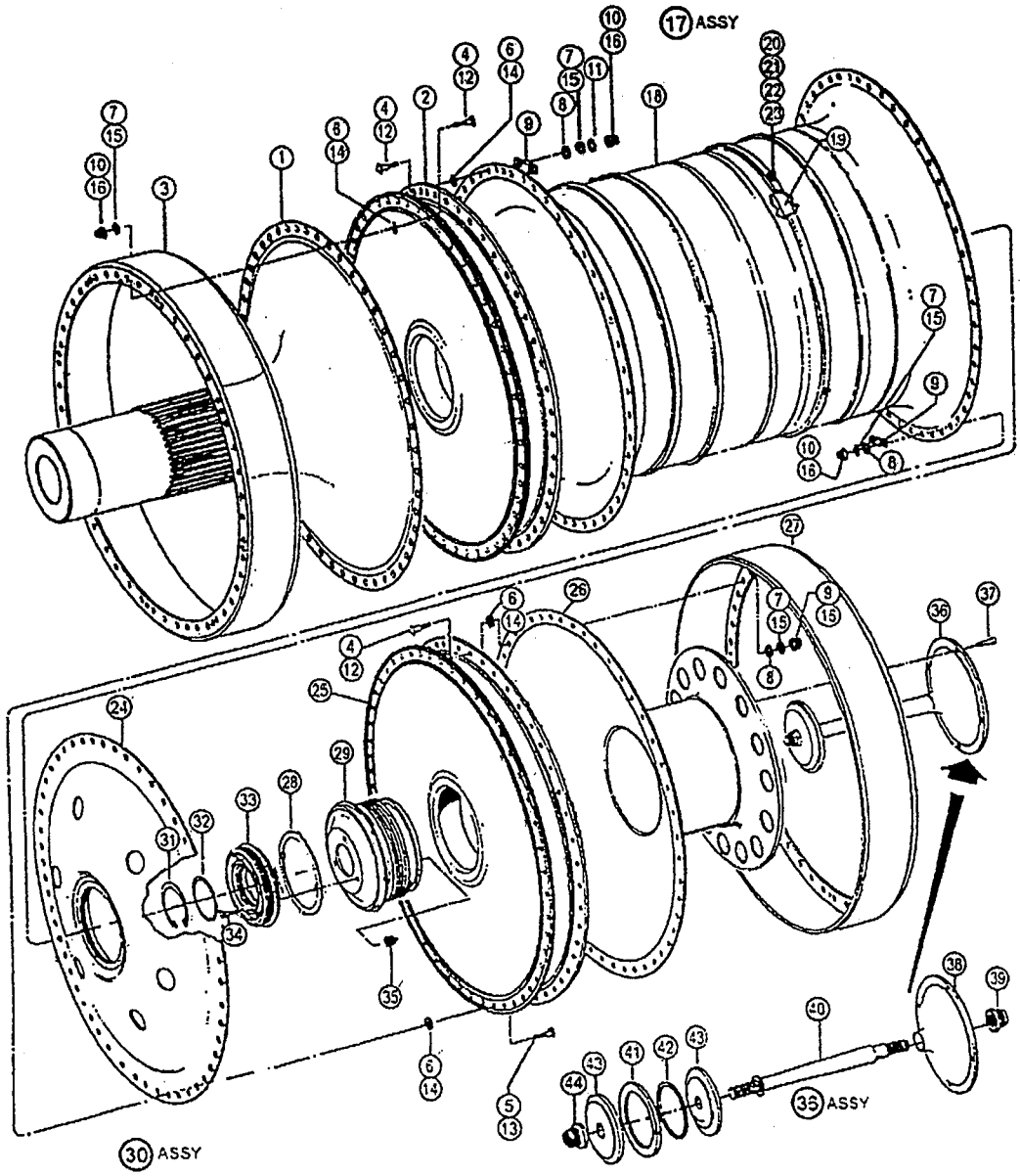

Figure 1 - High Speed Coupling Shaft Assembly Breakdown

C.1 Forward End:

Note: At each of the coupling bolt circles, three of the 48 nuts are larger and are installed on the three fitted bolts (forward end of each larger bolt shank is slotted).

Note: When removing D-headed bolts (Items 4, 5, 12, 13), be sure to record bolt diameter and thread length. Note that there are .4375" bolts with potentially different thread lengths and .375" bolts with potentially different thread lengths. Bolts with the same thread length need to be replaced in original bolted joint locations for balancing purposes.

a. Locate the three larger self-locking nuts (Item 16) in forward bolt circle of forward flexible coupling (Item 2) and mark them with an ink marker.

b. Match-mark forward anti-deflector ring (Item 3) to shaft distance piece (Item 18) and forward adapter (Item 1)

c. Mark all flat washers and push-on nuts (Items 6,7,14,15) around the forward anti-deflector ring (Item 3).

d. Remove the forty five smaller unmarked self-locking nuts (Item 10) on bolt circle of forward anti-deflector ring (Item 3) to separate forward flexible coupling (Item 2), forward adapter (Item 1), and forward anti-deflector ring (Item 3).

e. Loosen the three larger self-locking nuts (Item 16) at dowelled bolt locations on forward bolt circle one turn each, initially. Remove the three nuts.

f. Install six bolts (3/8-24 UNC) into jackscrew holes of forward anti-deflector ring (Item 3) and loosen ring from forward adapter (Item 1) by turning opposing bolts, one turn at a time, until ring is free of adapter.

g. Remove jacking bolts from forward anti-deflector ring, then carefully remove ring.

Note: Heat may be applied to the anti-deflector ring during removal. (Do not exceed 350° F). Do not use open flame for heating anti-deflector ring, use heat gun or other relatively low temperature heat source.

h. Mark all balance washers, push-on nuts, flat washers and balance plates (Items 6,14,9, 8, 7,15,11) around the forward end of the distance piece flange (Item 18).

i. Mark three larger self-locking nuts (Item 16) around forward end of distance piece flange (Item 18) with an ink marker.

j. Remove forty-eight nuts (Items 10 and 16) around the forward end of the distance piece flange (Item 18), separating the distance piece (Item 18) and the forward flexible coupling (Item 2). Use a crisscross method when loosening the nuts. Be sure to remove the forty-five smaller nuts before the three larger nuts.

k. Using an ink marker, identify forward flexible coupling (Item 2) as "forward coupling", and mark sides 1 and 2 (*See Figure 13*).

C.2 Aft End:

Note: At each of the coupling bolt circles, three of the 48 nuts are larger and are installed on the three fitted bolts (forward end of each larger bolt shank is slotted).

Note: When removing D-headed bolts (Items 4, 5, 12, 13), be sure to record bolt diameter and thread length. Note that there are .4375" bolts with potentially different thread lengths and .375" bolts with potentially different thread lengths. Bolts with the same thread length need to be replaced in original bolted joint locations for balancing purposes.

a. Match-mark the damper piston assembly (Item 36) to aft adapter (Item 26).

b. Remove piston cap screws (Item 37).

c. Remove damper piston assembly (Item 36) from aft adapter (Item 26).

Note: If damper piston assembly cannot be removed easily, use a gear puller modified to suit the application. Spray holes with WD40 to lube piston if necessary.

d. Match-mark aft anti-deflector ring (Item 27) to the distance piece (Item 18) and the aft adapter (Item 26).

e. Mark all flat washers and push-on nuts (Items 6,14,8,7,15) around the aft anti-deflector ring (Item 27).

f. Remove forty eight nuts (Items 10 and16) around the aft anti-deflector ring (Item 27) to separate the anti-deflector ring (Item 27), aft adapter (Item 26), and the aft flexible coupling (Item 25). Be sure to remove the forty-five smaller nuts before removing the three larger nuts.

Note: If the self-locking nut (Item 39) was removed from the piston damper assembly (Item 36), the piston assembly damper adapter (Item 38) will come off with the aft adapter.

g. Install six bolts (3/8-24 UNC) into jackscrew holes of aft anti-deflector ring (Item 27) and loosen ring from aft adapter (Item 26) by turning opposing bolts one turn at a time until ring is free of adapter.

h. Remove jacking bolts from aft anti-deflector ring (Item 27), then carefully remove anti-deflector ring.

Note: Heat may be applied to the anti-deflector ring during removal. (Do not exceed 350° F). Do not use open flame for heating anti-deflector ring, use heat gun or other relatively low temperature heat source.

i. Mark all balance washers, push-on nuts and flat washers (Items 6, 14, 9, 8, 7, 15) around the aft flange of the distance piece (Item 18).

j. Remove forty-eight nuts (Items 10 and16) around the aft flange of the distance piece (Item 18) to separate distance piece (Item 18), damper diaphragm (Item 24), plug assembly (Item 30), and aft flexible coupling (Item 25). Use a crisscross method when

loosening nuts. Be sure to remove the forty-five smaller nuts before removing the three larger nuts.

k. Using an ink marker, identify aft flexible coupling (Item 25) as "aft coupling", and mark sides 1 and 2 (*See Figure 17*).

C.3 Shaft Assembly:
(Item 17)

a. Match-mark damper rings (Item 19) to distance piece (Item 18).

b. Remove shoulder bolts, washer and self-locking nuts (Items 20, 21, 22, 23) to separate damper rings (Item 19) and distance piece (Item 18).

c. Use snap ring pliers to compress the damper rings (Item 19) for removal from distance piece (Item 18).

C.4 Damper Piston Assembly:
(Item 36)

a. Remove two self-locking nuts (Items 39 and 44) at the ends of the damper piston assembly (Item 36) to separate piston assembly damper adapter (Item 38), piston assembly damper rod (Item 40), piston assembly rings (Items 41,42), and piston assembly damper locking plate (Item 43).

C.5 Plug Assembly:
(Item 30)

a. Remove three self-locking nuts (Item 35) and machine bolts (Item 34) to separate retainer ring (Item 28), cylinder damper (Item 29), and threaded damper plug (Item 33).

b. Unscrew threaded damper plug (Item 33) from the damper diaphragm (Item 24) to separate threaded damper plug (Item 33), spacer damper ring (Item 32), and internal retaining ring (Item 31).

D. COMPONENT INSPECTION PROCESS

D.1 Component Inspection Documentation

The following descriptions identify several detailed processes and procedures that may occur during component inspection. Each is to be provided by the refurbisher and approved by the customer prior to implementation.

- Document containing a detailed step-by-step procedure for scribing the components.
- Document containing procedures and agents that will be used to clean and blast the coupling.
- Document containing details about surface preparation, paint application, and corrosion protection.
- Document that covers engineering requirements for electrodeposition and plating methods, should any parts require replating.

D.2 Aft Adapter

(Item 26)

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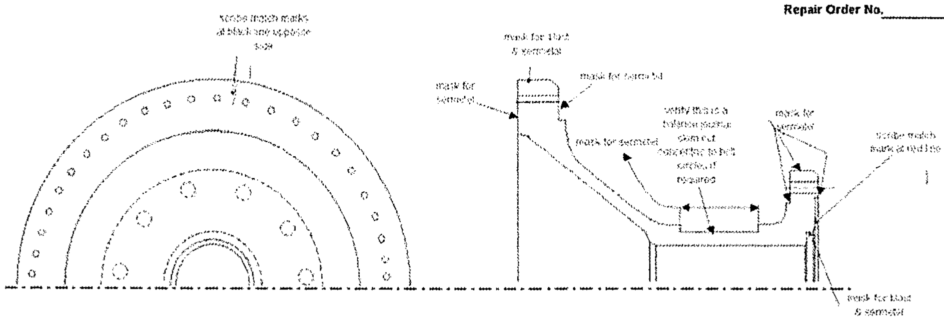


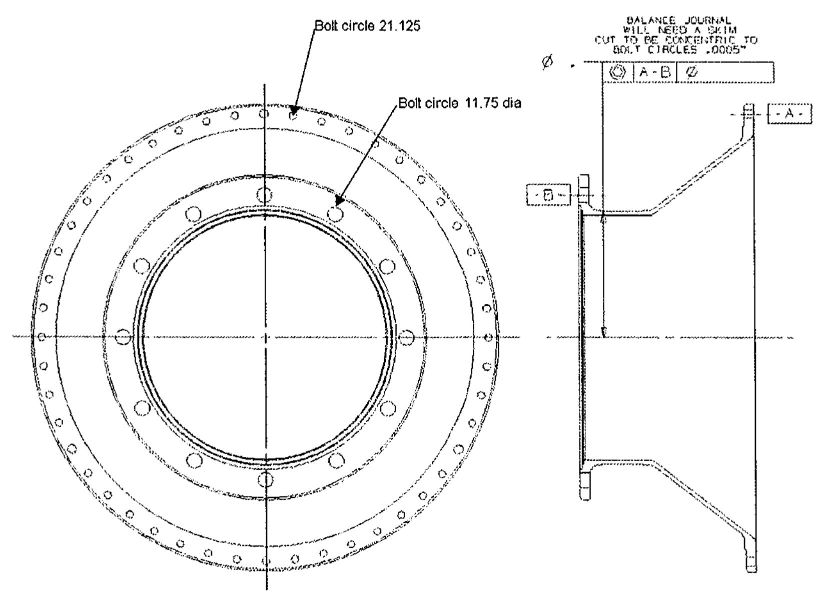
Operation Description	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Aft Adapter [illegible] # 26				
10 Scribe match mark line on Aft and [illegible] Adapter **(See Section D.1)**				
20 Degrease				
30 Blast **Coupling (See Section D.1)**				
40 Visually inspect [illegible] engineering if part is rejected [*]				
50 Magnetic Particle inspect per MIL-STD-[illegible]				
60 Bolt holes [illegible]				
70 Inspect 4 tapped holes to -3B tolerances and measure [illegible]				
80 Measure part OD and concentricity to bolt circles and record along with [illegible] determine if [*] balance journal [illegible]				
90 Measure length and total runout, record				
100 Weigh part without bolts or nuts, record				
110 Component balance to [illegible] [*]				
120 Paint **Coupling (See Section D.1)**				

Operation Description	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Bolts (12)				
10 Degrease				
20 Visual inspect				
30 Dye Penetrant per MIL-STD-[illegible] A				
40 Inspect threads to -3A tolerances and record diameters [illegible] [*]				
50 Report if replacements are needed [*]				

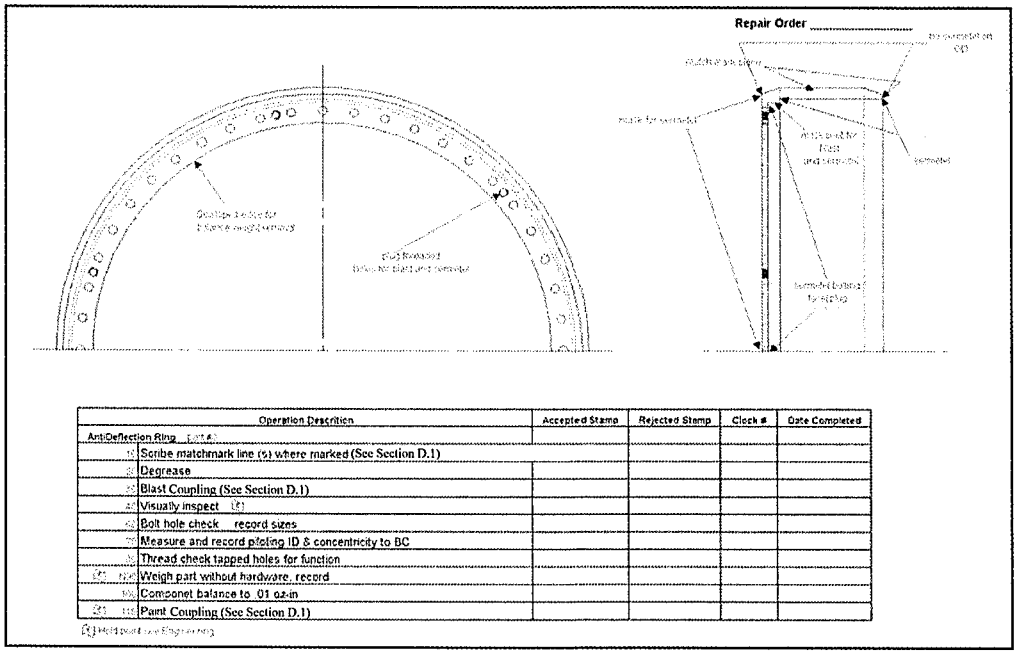
Operation Description	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Nuts (12)				
10 Degrease				
20 Visual inspect				
30 Dye Penetrant per MIL-STD-[illegible] A				
40 Inspect 4 tapped holes to -3B tolerances and measure [illegible]				
50 **Report if replacements are necessary** [*]				

[*] Hold point see Engineering

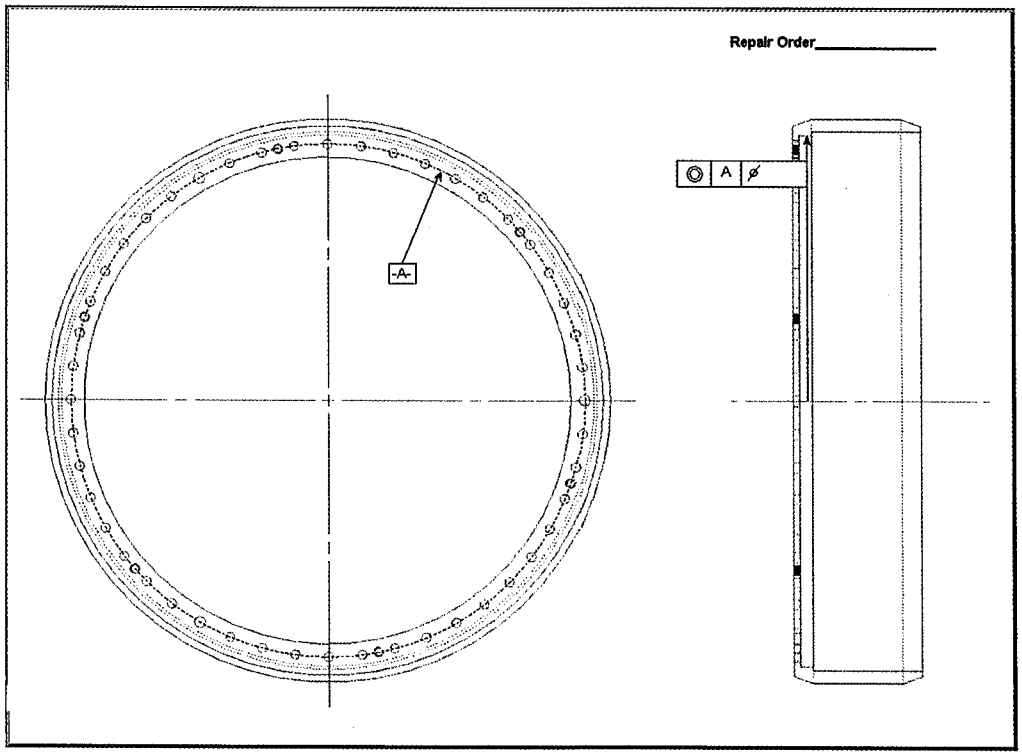
Repair Order __________



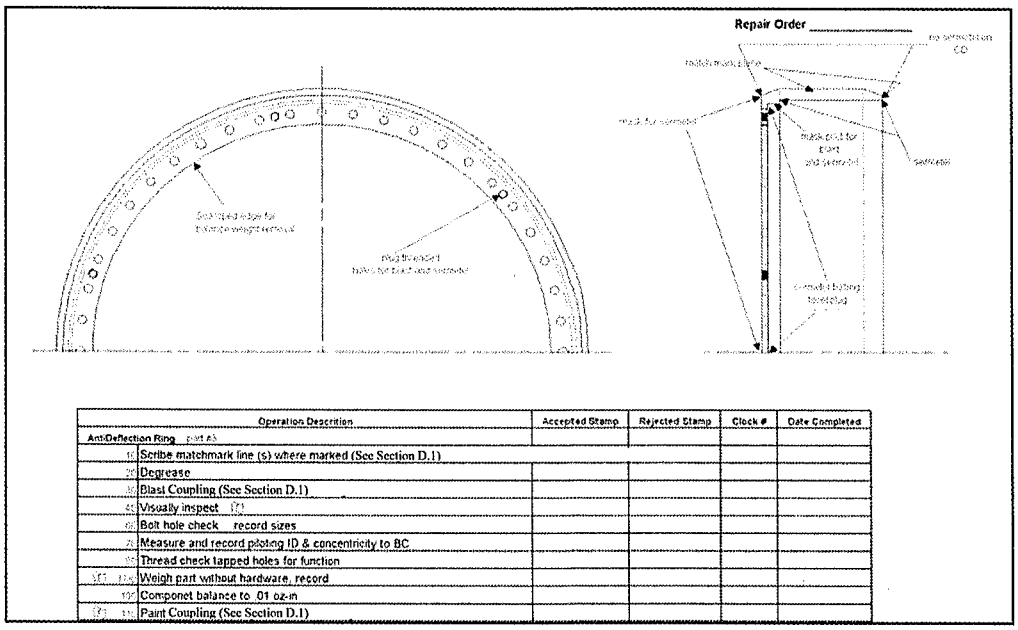
D.3 Aft Anti-Deflector Ring
(Item 27)



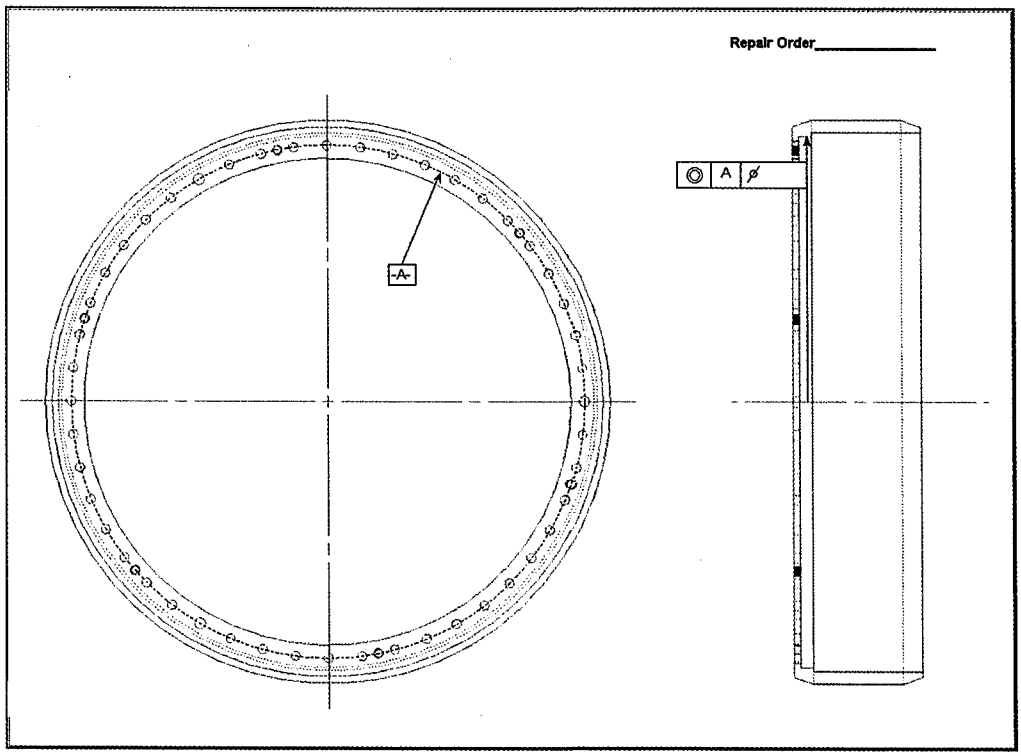
Operation Description	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Anti-Deflection Ring				
Scribe matchmark line (s) where marked (See Section D.1)				
Degrease				
Blast Coupling (See Section D.1)				
Visually inspect				
Bolt hole check record sizes				
Measure and record piloting ID & concentricity to BC				
Thread check tapped holes for function				
Weigh part without hardware, record				
Componet balance to .01 oz-in				
Paint Coupling (See Section D.1)				



D.4 Forward Anti-Deflector Ring
(Item 3)



	Operation Description	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Anti-Deflection Ring					
	Scribe matchmark line (s) where marked (See Section D.1)				
	Degrease				
	Blast Coupling (See Section D.1)				
	Visually inspect				
	Bolt hole check record sizes				
	Measure and record piloting ID & concentricity to BC				
	Thread check tapped holes for function				
	Weigh part without hardware, record				
	Componet balance to .01 oz-in				
	Paint Coupling (See Section D.1)				



D.5 Cylinder Damper
(Item 29)

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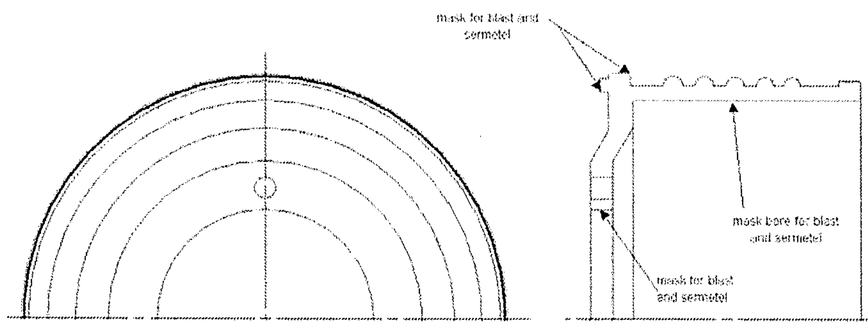


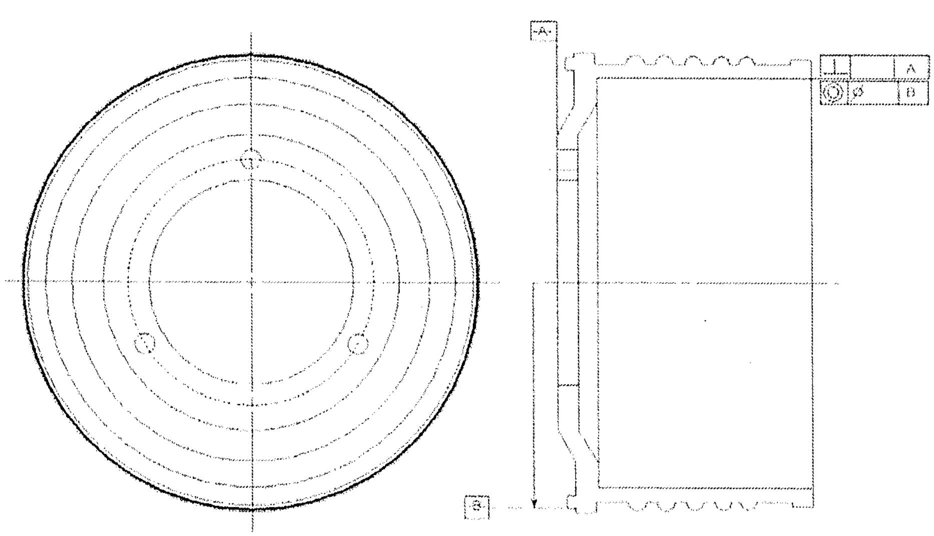
	Operation Desription	Accepted Stamp	Rejected Stamp	Clock#	Date Completed
Cylinder Dampener	part # 29				
10	scribe mm line, already marked with marker **(See Section D.1)**				
20	clean				
30	blast **Coupling (See Section D.1)**				
40	visually inspect [C]				
50	Magnetic Particle inspect per MIL-STD-1907 (B)				
60	measure and record bolt hole size,and bore, and concentricity to piloting OD				
N70	Weigh Part with Hardware, will be component balanced with Damper Diaphragm				
80	Paint **Coupling (See Section D.1)**				

Bolts (3)	part # 34				
10	clean w/acetone (soft brush permitted)				
20	visually inspect [C]				
30	zyglow inspect per MIL-STD-1907 (B)				
40	thread check to -2A tolerances				

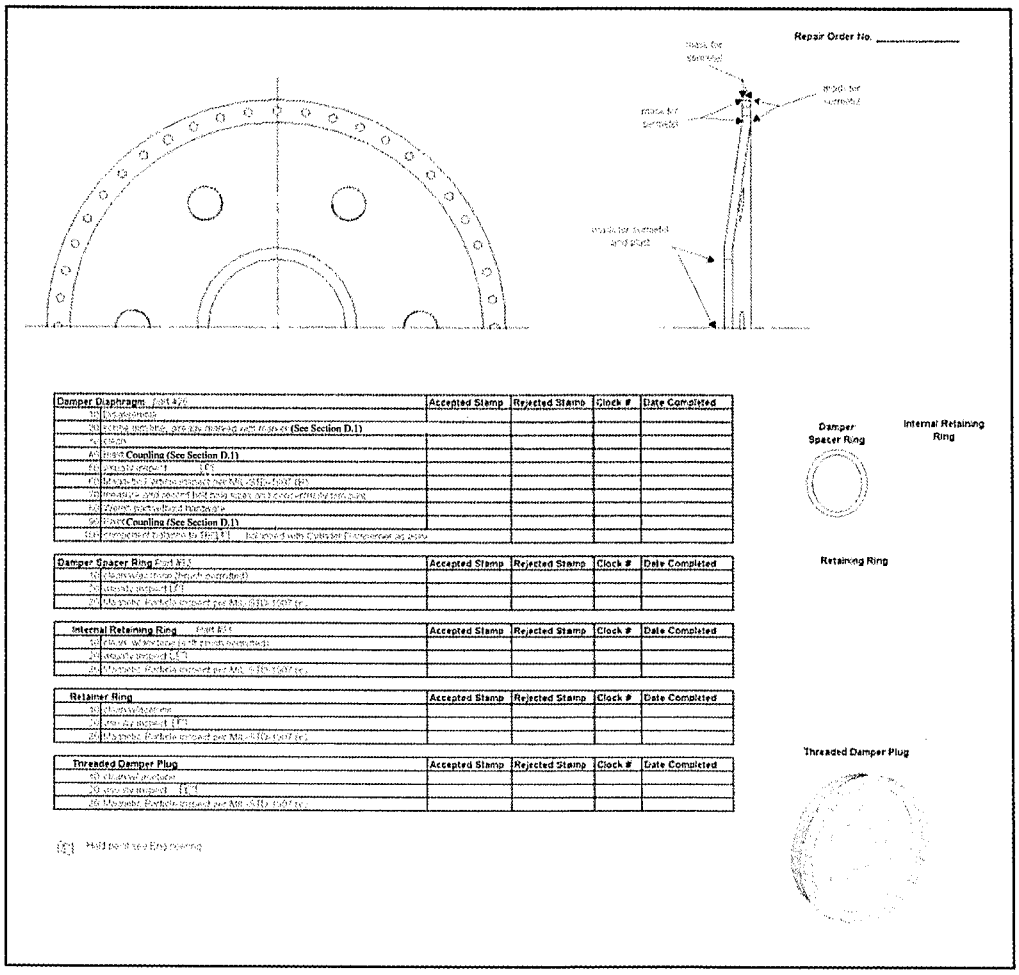
Nuts(3)	part #35				
10	Vendor clean with acetone, soft brush permitted				
20	vendor remove plating				
30	visually inspect [C]				
40	dyepenetrant inspect per MIL-STD-1907 (B)				
50	silver plate **Coupling (See Section D.1)**				
60	thread check to -2B tolerances				

[C] Hold Point See Engineering

Repair Order No. ________



D.6 Damper Diaphragm
(Item 24)



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Damper Diaphragm	Accepted Stamp	Rejected Stamp	Clock #	Date Completed

Damper Spacer Ring	Accepted Stamp	Rejected Stamp	Clock #	Date Completed

Internal Retaining Ring	Accepted Stamp	Rejected Stamp	Clock #	Date Completed

Retainer Ring	Accepted Stamp	Rejected Stamp	Clock #	Date Completed

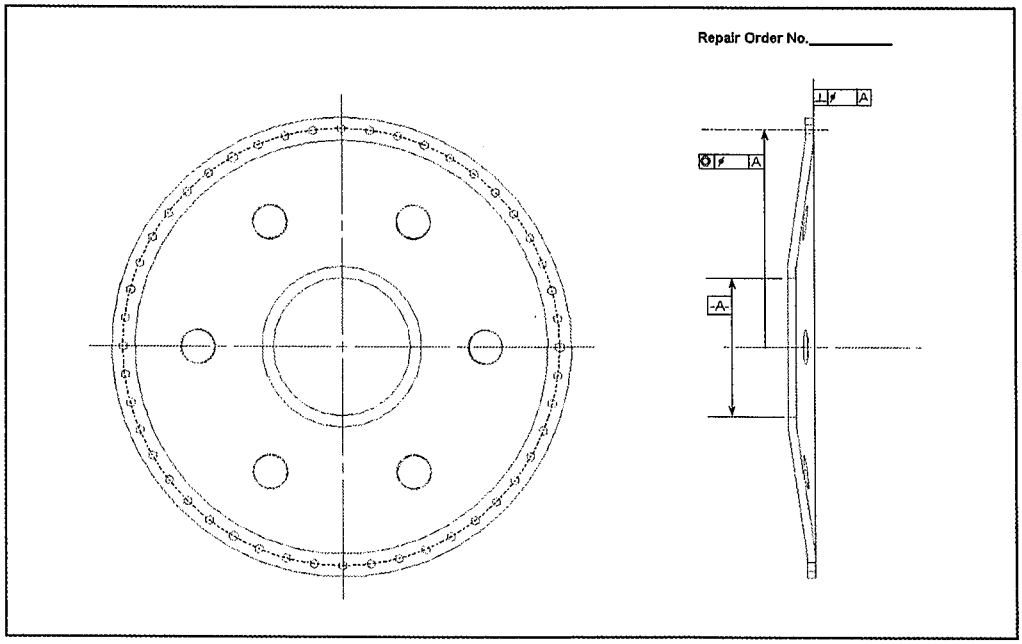
Threaded Damper Plug	Accepted Stamp	Rejected Stamp	Clock #	Date Completed

Damper Spacer Ring

Internal Retaining Ring

Retaining Ring

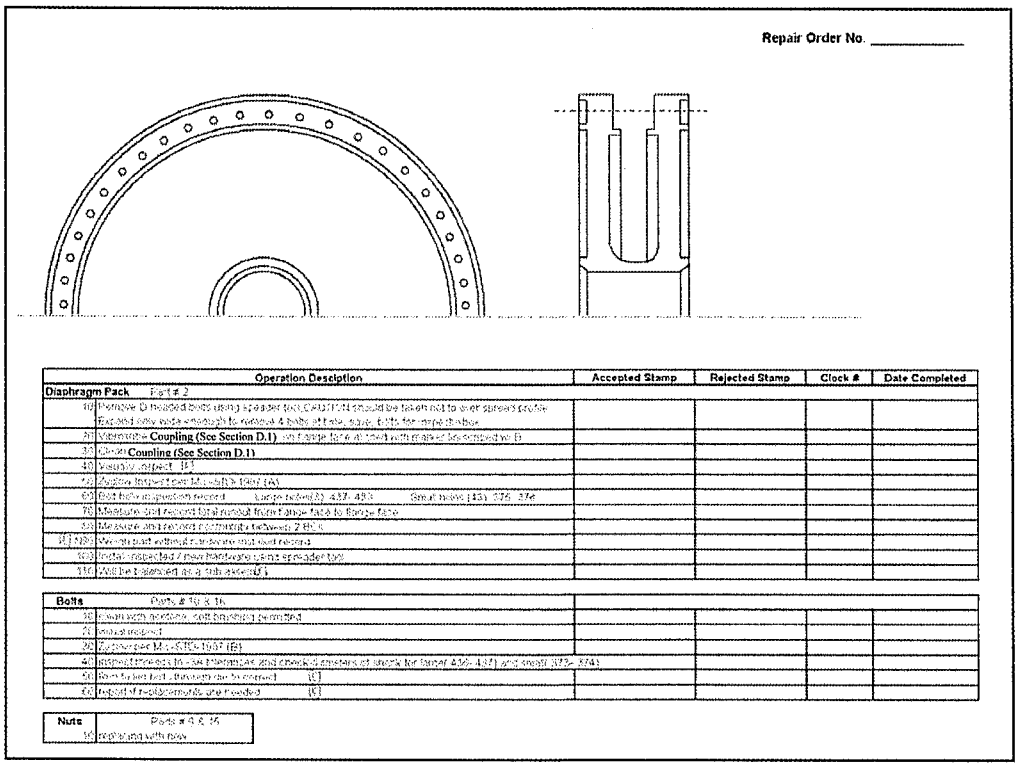
Threaded Damper Plug

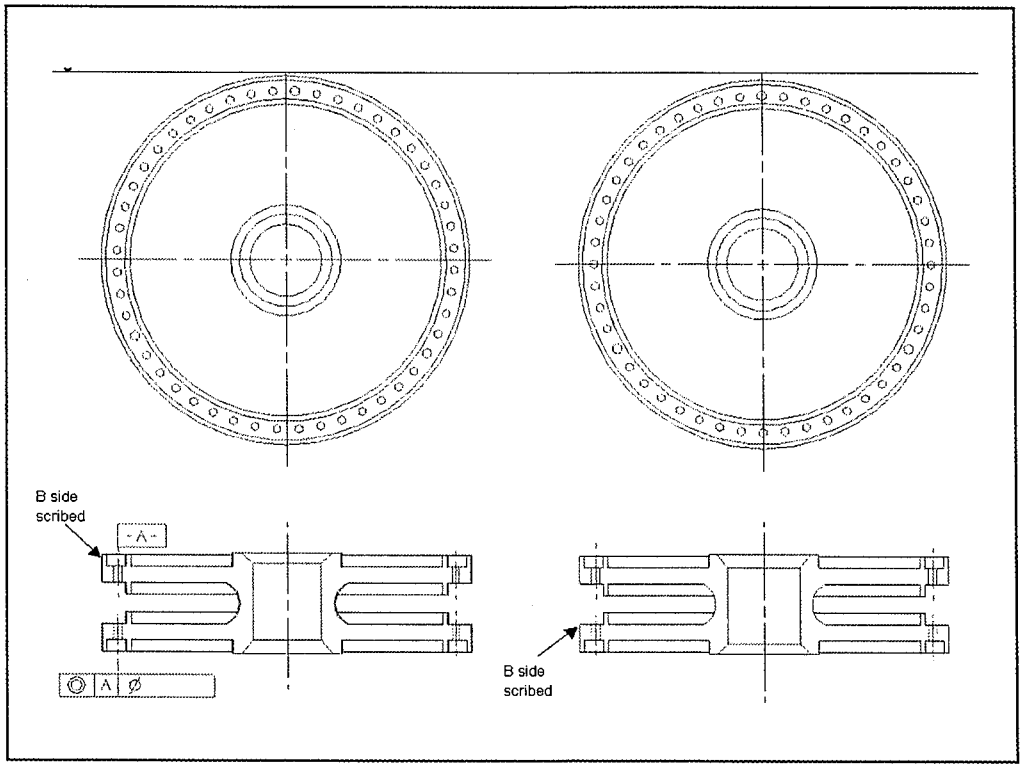


Repair Order No._____

D.7 Forward Flexible Coupling
(Item 2)

Note: When removing D-headed bolts (Items 4, 5, 12, 13), be sure to record bolt diameter and thread length. Note that there are .4375" bolts with potentially different thread lengths and .375" bolts with potentially different thread lengths. Bolts with the same thread length need to be replaced in original bolted joint locations for balancing purposes.



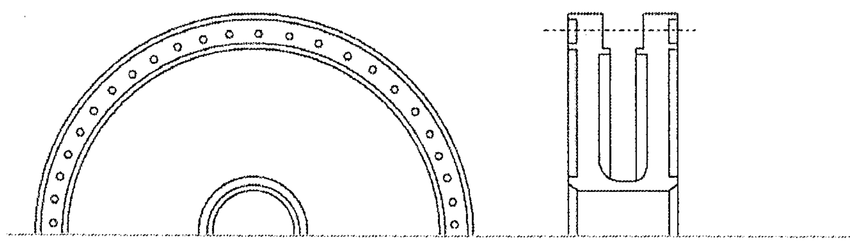


D.8 Aft Flexible Coupling

(Item 25)

Note: When removing D-headed bolts (Items 4, 5, 12, 13), be sure to record bolt diameter and thread length. Note that there are .4375" bolts with potentially different thread lengths and .375" bolts with potentially different thread lengths. Bolts with the same thread length need to be replaced in original bolted joint locations for balancing purposes.

Repair Order No. ___________

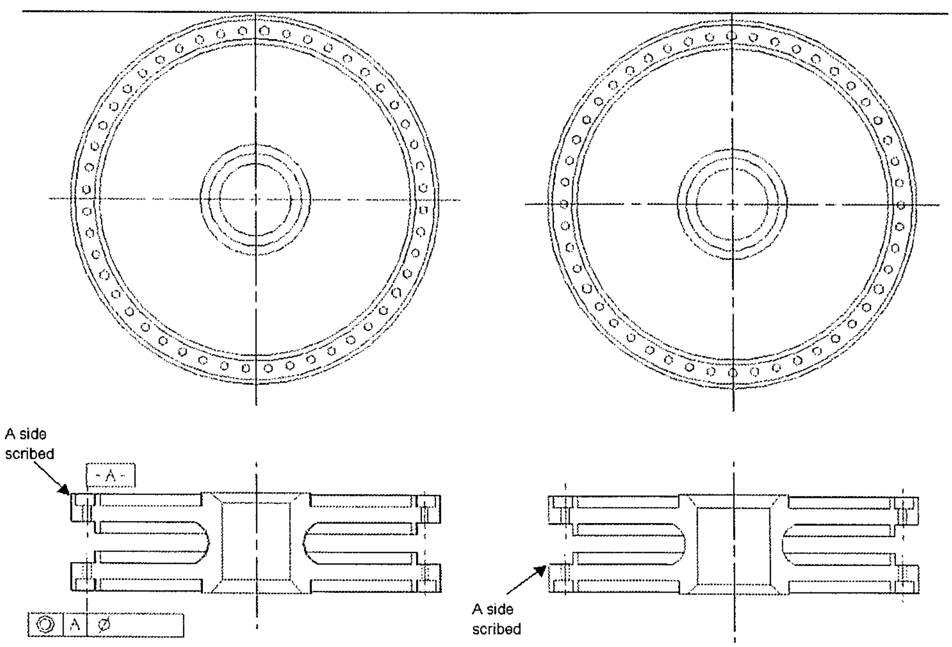


	Operation Desciption	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Diaphragm Pack	Part # 25				
10	Remove D headed bolts using spreader tool, CAUTION should be taken not to over spread [illegible] Expand only wide enough to remove 4 bolts at time, save bolts for inspection				
20	[illegible] **Coupling (See Section D.1)** on flange face aligned with marker line (location A)				
30	Clean **Coupling (See Section D.1)**				
40	Visually inspect (E)				
50	Dye Penetrant inspect per MIL-STD-1907 (A)				
60	Bolt hole inspection record Large holes(5) .437-.439 Small holes (4.5) .375-.376				
70	Measure and record total runout from flange face to flange face				
80	Measure and record concentricity between 2 ID's				
90	Weigh part without hardware installed record				
100	Install inspected / new hardware [illegible]				
110	Will be balanced as a subassembly				

		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
Bolts	Parts # 10 & 16				
10	clean with acetone, soft brushing permitted				
20	visual inspect				
30	Zyglow per MIL-STD-1907 (B)				
40	inspect threads to -3A tolerances and check diameters of shank for large(.4375-.437) and small (.375-.376)				
50	run failed bolts through die to correct				
60	report if replacements are needed [illegible]				

Nuts	Parts # 9 & 15
10	replace with new

Repair Order No.__________



D.9 Distance Piece
(Item 18)

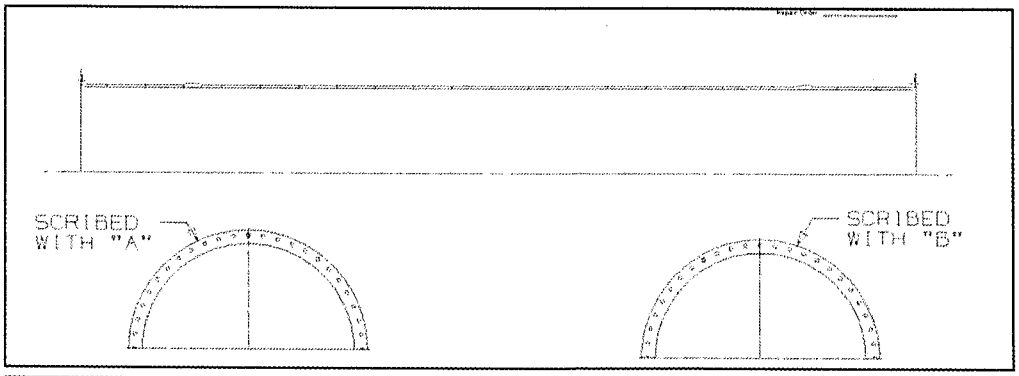
Center tube	part # 10	Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	Match mark break and side of radial springs with permanent marker				
20	Vibroscribe matchmarks (See Section D.1) on OD, already marked with marker				
30	Remove radial springs, care should be taken not to scratch sermetal				
40	Degrease				
50	Visually inspect.				
60	Blast Coupling (See Section D.1)				
70	Dye penetrant inspect OD and flanges, not ID per MIL-STD-1907 (B)				
80	measure and record bolt hole sizes (S) .375-.378 GO (L) .437-.438 GO				
90	measure length(flange to OD); record				
HOLD 100	reinstall radial Springs				
110	Paint Coupling (See Section D.1)				
120	Weigh part record				
130					

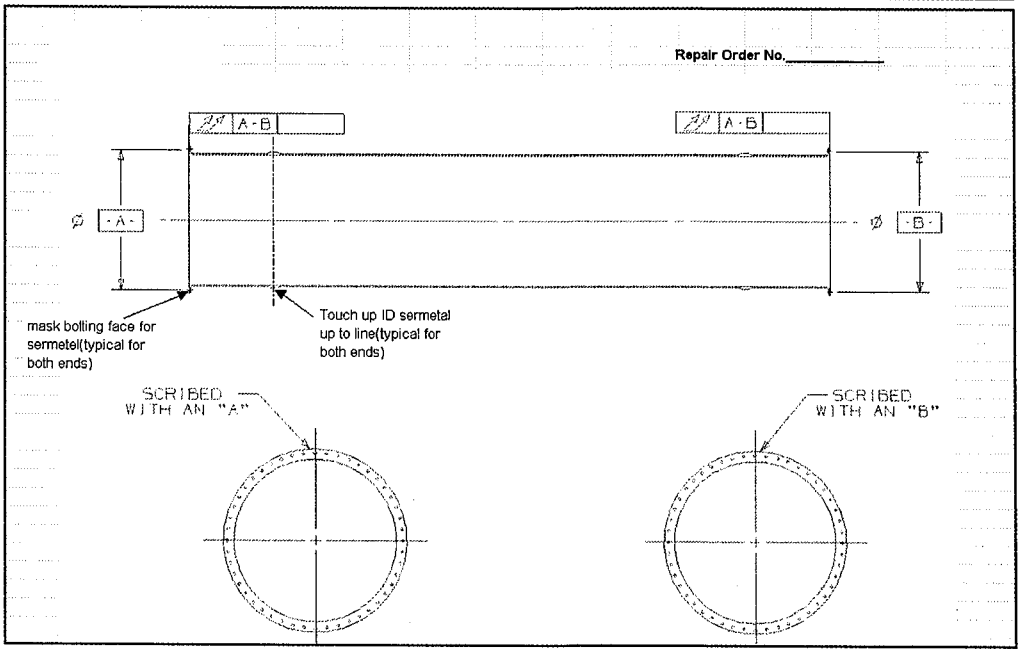
Radial Springs		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	remove				
20	Clean with acetone, soft brush is acceptable				
30	Visually inspect				
40	Zyglow inspect per MIL-STD-1907 part (C)				
50	Weigh with hardware record				
60	Do not remove matchmark(s)				

Bolts		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	remove save washers if they exsist note location				
20	clean w/ acetone and soft brush				
30	Zyglow inspect per MIL-STD-1907 (B)				
40	inspect threads to -2A tolerances				

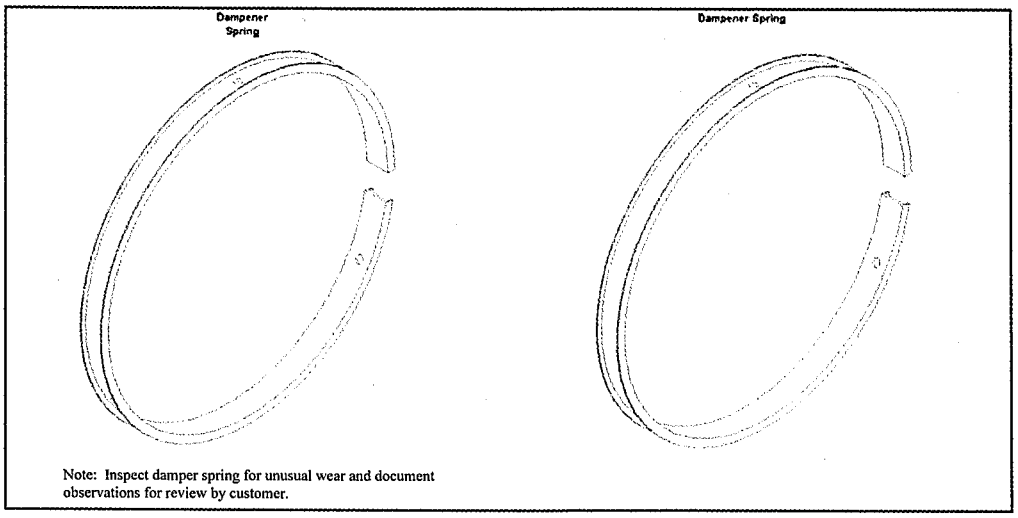
Nuts		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	remove				
20	clean w/acetone (soft brush permitted)				
30	Zyglow inspect per MIL-STD-1907 (B)				
40	inspect threads to -2B tolerances				

Washers	
10	New Washers will be bought





D.10 Damper Rings
(Item 19)



Note: Inspect damper spring for unusual wear and document observations for review by customer.

D.11 Forward Adapter
(Item 1)

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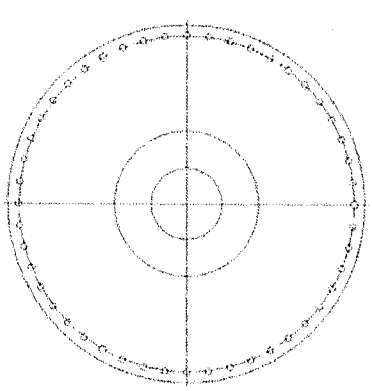
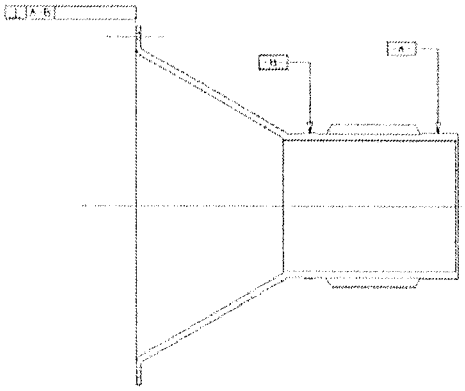
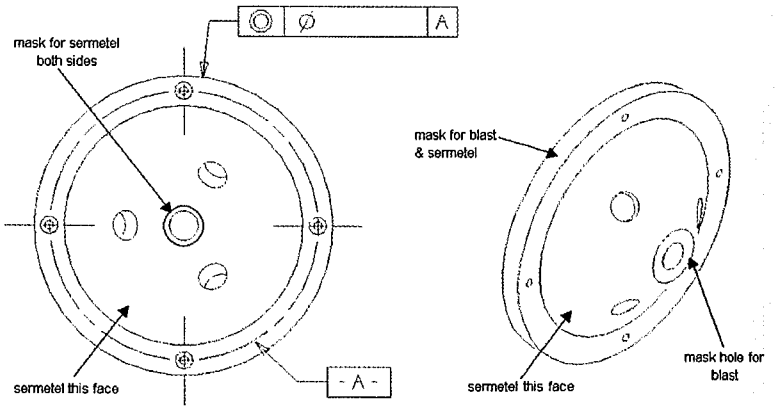




Forward Adapter Part #1		Accepted Stamp	Rejected Stamp	Clock #	Date
10	Scribe mm line, already marked with marker (See Section D.1)				
20	Degrease with acetone, soft brush is permitted				
30	Visually inspect				
40	Zyglow inspect per MIL-STD-1907 1A)				
50	Internal Spline inspection record (1), visually identify damage to splines and document findings for review by customer.				
60	Examine Ratcheting Internal Spline for broken threads				
70	Bolt hole check Go/No Go (L)(3) .437-.438 (S)(43) .375-.376				
80	check concentricity of BC to suspect balance journals and pilot OD record				
90	Wash part, record				

D.12 Piston Assembly Damper Adapter
(Item 38)

Repair Order _____



Damper Diaphragm		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	Disassemble				
20	scribe mm line, already marked with marker (See Section D.1)				
30	clean				
40	blast per ps 242 method F, mask as noted				
50	visually inspect				
60	Magnetic Particle inspect per MIL-STD-1907 (B)				
70	measure and record bolt hole sizes and concentricity to pilot.				
80	weigh part record				
90	Paint Coupling (See Section D.1)				
100	balanced as a sub-assembly				

Piston Cap Screw		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	Clean, with acetone, soft brush permitted				
20	Visually inspect				
30	Zyglow per MIL-std-1907 (B)				
40	thread check to -2A tolerances				

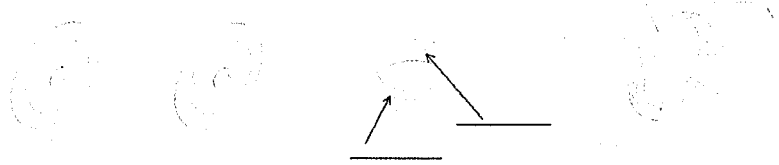
D.13 Damper Piston Assembly Parts
(Items 41, 42, 43)

Repair Order_____

Large Piston Ring

Piston Assembly Plates

Small piston ring



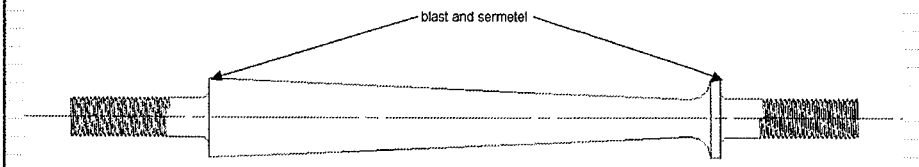
Piston Assembly Plate (both)		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	note end before removal				
20	clean w/acetone (soft brush permitted)				
30	visually inpect				
40	Magnetic Particle inspect per MIL-STD-1907 (B)				

Piston Assembly Ring (S)		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	note direction and end before removal				
20	clean w/acetone(soft brush permitted				
30	visually inspect				
40	measure OD & ID and record				
50	Magnetic Particle inspect per MIL-STD-1907 (B)				

Piston Assembly Ring (L)		Accepted Stamp	Rejected Stamp	Clock #	Date Completed
10	note direction and end before removal				
20	clean w/acetone (soft brush permitted)				
30	visually inspect				
40	measure ID, OD and gap - record				
50	Magnetic Particle inspect per MIL-STD-1907 (B)				

D.14 Piston Assembly Damper Rod
(Item 40)

Repair Order_____



Rod		Accepted stamp	Rejected Stamp	Clock #	Date Completed
10	clean w/acetone (soft brush is acceptable)				
20	blast Coupling (See Section D.1)				
30	visually inpect				
40	Magnetic Particle inspect per MIL-STD-1907 (B)				
50	thead check to -2A tolerances				
60	measure concentricity using shank diameters for V block to deteremine if bent record				
70	weigh Part, record				

Locking Nut (both)		Accepted stamp	Rejected Stamp	Clock #	Date Completed
10	note end and color, for reassembly				
20	clean				
30	visaully inpect				
40	Dye Penetrant Inspect per MIL-STD-1907 (B)				
50	thread check to -2A tolerances				

E. ASSEMBLY AND BALANCE

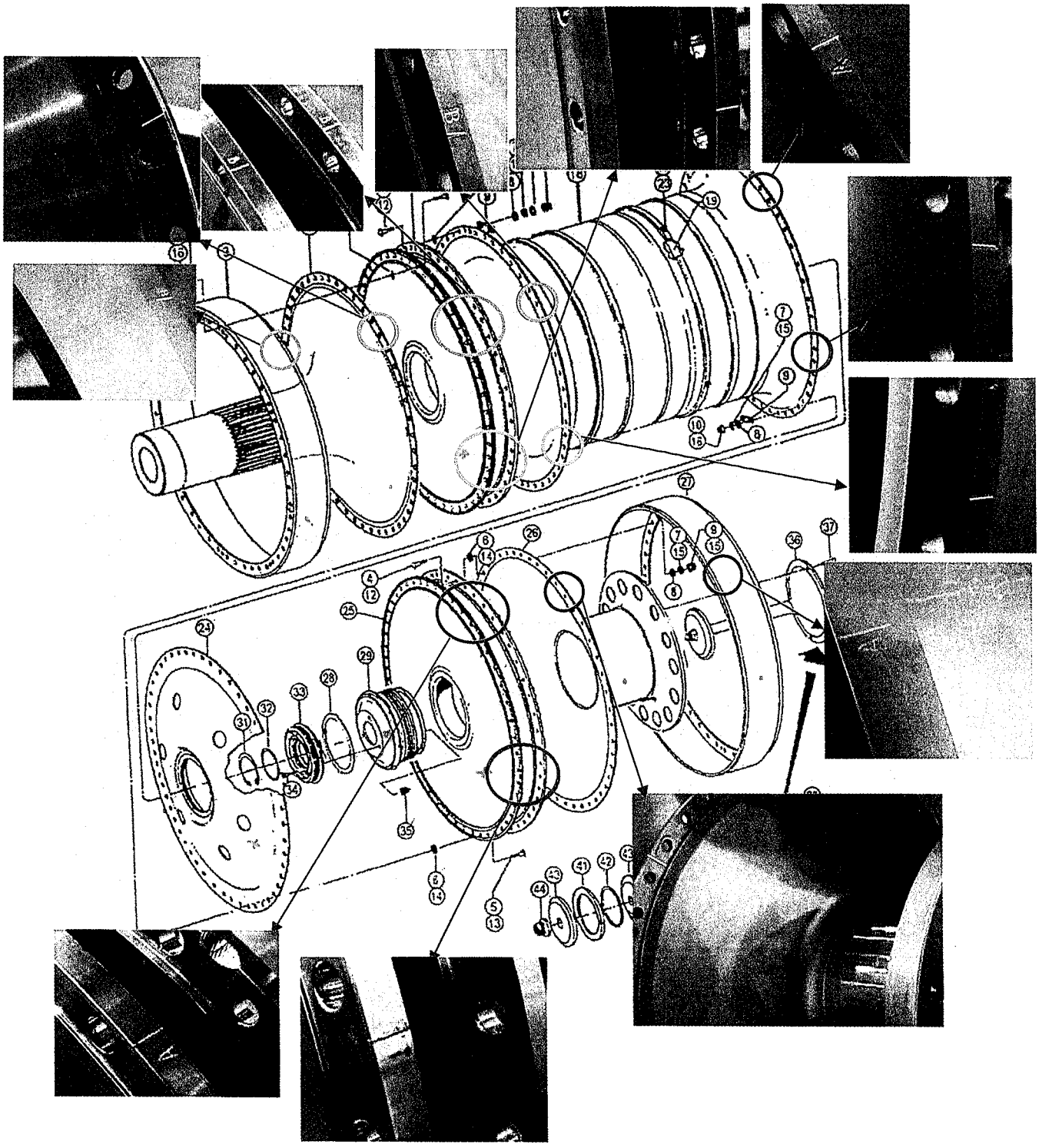


Figure 2 – Match-Mark Assembly

E.1 Assembly of small components

Note: Reference *Table 3-Replacement Parts* for mandatory replacement parts.

E.1.1 Shaft Assembly
(Item 17)

a. Use internal snap ring pliers to compress the radial damper rings (Item 19). Once compressed use a wire of approximately 1/16" diameter to hold ring compressed. Insert damper rings (Item 19) into distance piece (Item 18) and align holes and match-marks on distance piece with holes on damper rings. (*See Figure 3*) Each ring is marked with the end it is to be installed in.

Note: After inserting damper rings into distance piece, wire may have to be released from damper ring to line up holes.

b. Insert shoulder bolts (Item 20) from the inside of distance piece with one large washer (Item 21 – See Table 3). Apply medium locktight to threads of bolt, then add one small washer (Item 22 - See Table 3) over bolt. Add self-locking nut (Item 23) and torque to approximately 80 in-lbs.

Note: The nut will bottom out on the oversized shoulder of bolt, which allows radial motion in the bolt nut assembly relative to the distance piece by design.

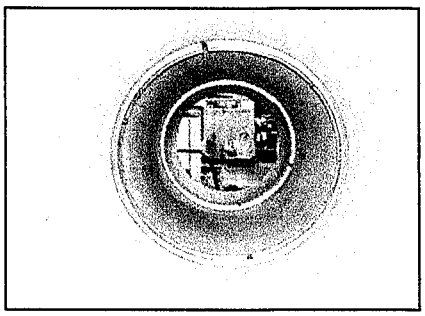


Figure 3 - Installed Damper Rings

E.1.2 Damper Piston Assembly
(Item 36)

a. Attach piston assembly damper adapter (Item 38) to piston assembly damper rod (Item 40), and tighten nut (Item 39) to 1200 in-lbs. (*See Figure 4*)

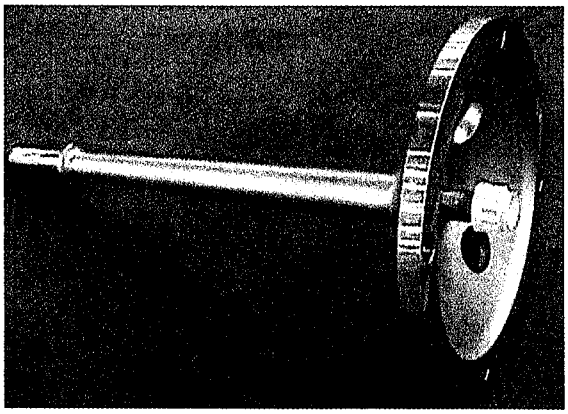


Figure 4 - Piston Damper Rod Assembly w/Damper Adapter

b. On opposite end of piston damper rod, attach the piston assembly rings (Items 41 and 42), and piston assembly damper locking plates (Item 43) with a self-locking nut (Item 44), and torque to 1200 in-lbs. Note the proper order and orientation of items on piston damper rod. (*See Figures 1 and 5*)

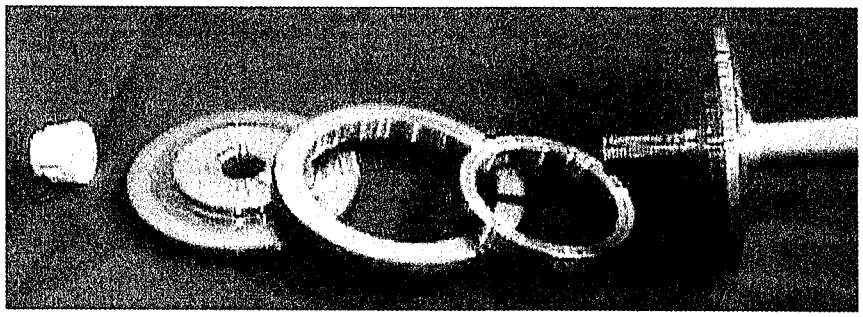


Figure 5 - Piston Assembly Damper Rod w/Rings and Plates

E.1.3 Plug Assembly
(Item 30)

a. Tighten the threaded damper plug (Item 33) to the damper diaphragm (Item 24). Once a reasonable resistance is felt, tighten until match-marks line up (*See Figure 6*). This will ensure that enough torque has been applied. Company performing Refurbishment shall provide any special tooling that may be required for this step.

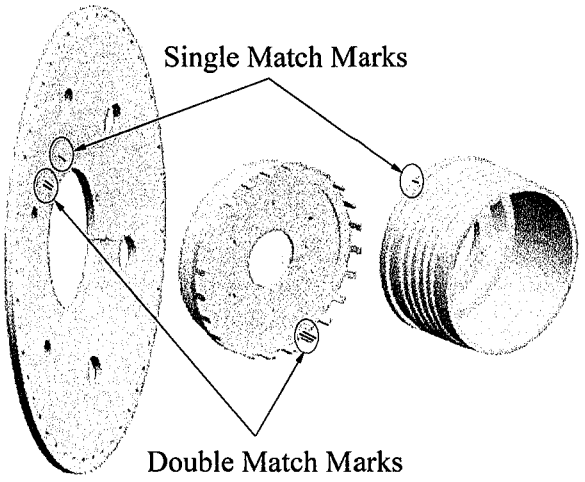


Figure 6 - Plug Assembly

b. Place the three machine bolts (Item 34) into the holes of the threaded damper plug (Item 33). Insert the spacer damper ring (Item 32) and the internal retaining ring (Item 31), which must be compressed in order to place into groove of threaded damper plug. (*See Figures 7 and 8*)

Note: Use internal snap ring pliers to compress the internal retaining ring.

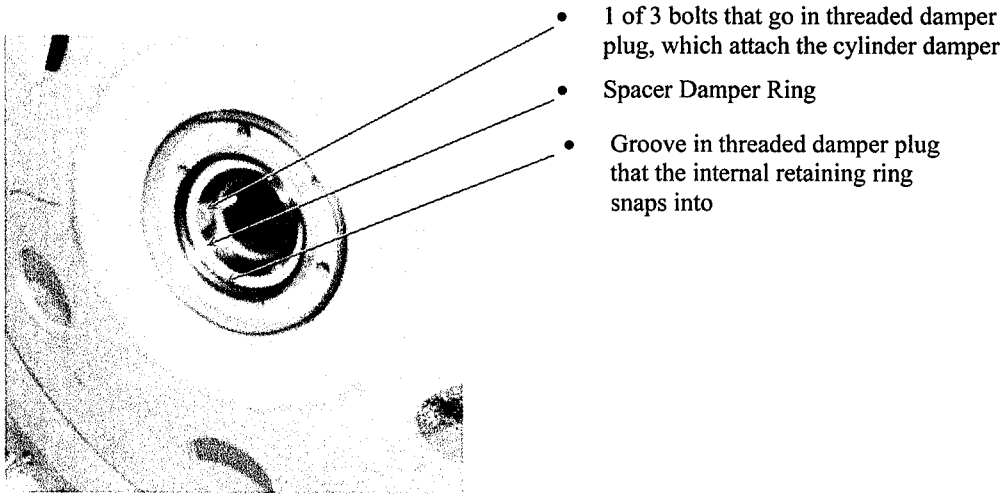


Figure 7 - Forward Side of Damper Diaphragm

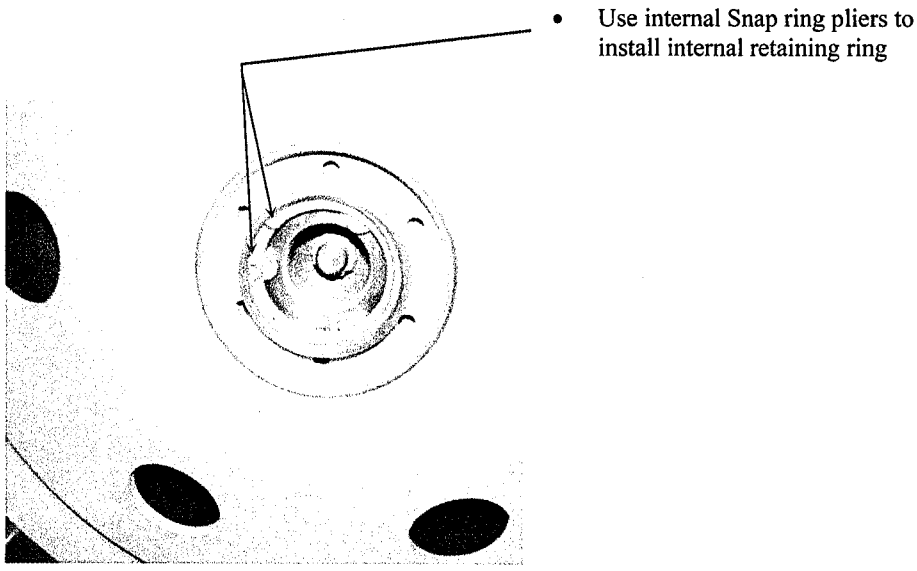


Figure 8 - Forward Side of Damper Diaphragm w/Internal Retaining Ring

c. Before securing the cylinder damper (Item 29) to the threaded damper plug (Item 33), place the retainer ring (Item 28) onto the threaded damper plug (*See Figure 9).* As you continue to attach the cylinder damper (Item 29) onto the threaded damper plug, check the orientation with the damper diaphragm (Item 24), and make sure the match-marks align with each other (*See Figure 6).* Then, secure using the self-locking nuts (Item 35), tightening them to 7-10 ft-lbs. of torque. (*See Figure 10*)

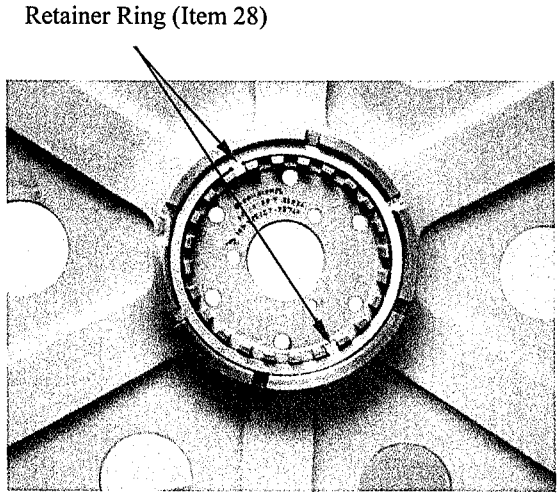


Figure 9 - Aft Side of Damper Diaphragm w/Retaining Ring

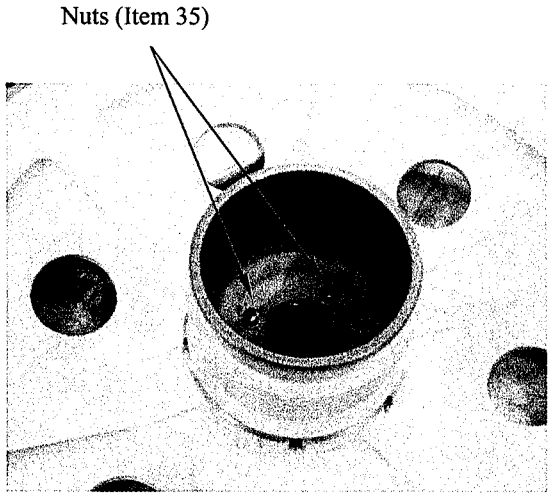


Figure 10 - Aft Side of Damper Diaphragm w/Cylinder Damper

E.2 Bolts

E.2.1 Bolt Identification and Installation Location

a. Below, the main torque carrying bolts are identified (*See Figure 11*). Note the difference in bolt diameters. Parts "A" & "B" have .375" shank diameters (Items 4 or 5), while Parts "C" &"D" have .4375" shank diameters (Items 12 or 13). Furthermore note the difference in grip lengths for each diameter bolt.

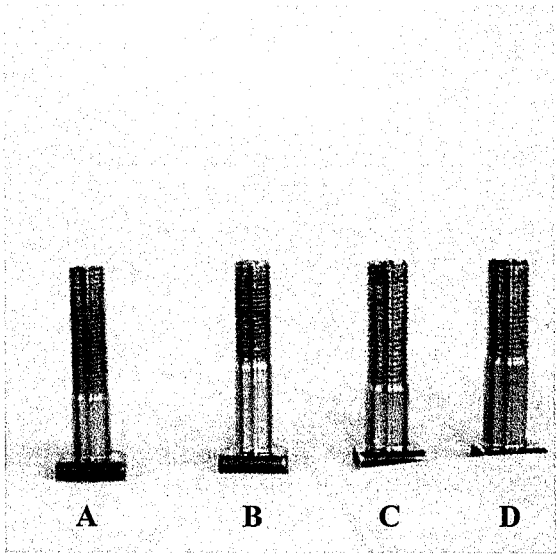


Figure 11 – Bolt Identification

b. Note the installation location (*See figure 12*). In the final assembly there are forty-eight bolts per interface, three large diameter bolts and forty-five small diameter bolts. Be sure to install the different thread lengths in original locations identified during disassembly to minimize unbalance. If bolts are not weight matched, they shall be separated by weight and distributed evenly to minimize weight removal during balancing.

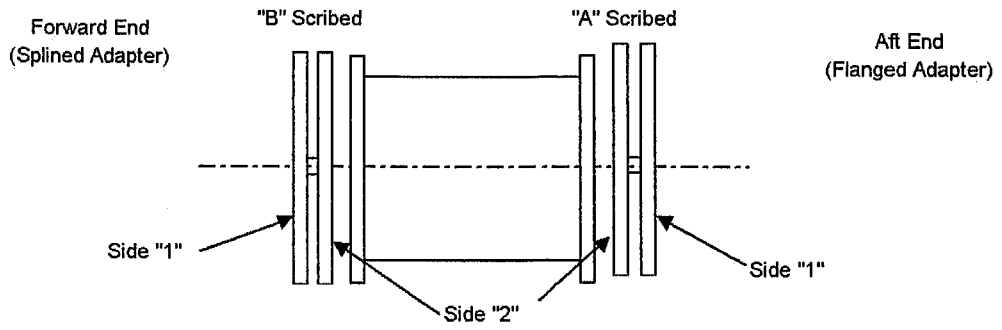


Figure 12 - Bolt Location Diagram

E.2.2 Method for Installing Bolts into Diaphragm

a. Separate the flexible coupling, only spreading it wide enough to insert two bolts in on either side of the spreader at one time. Do not over spread the flexible couplings.

E.3 Forward End Sub Assembly for Balance

a. Install bolts (Items 4 and 12) into forward flexible coupling (Item 2) using the installation procedure from section E.2. Note the flexible coupling is marked with an ink marker (Side "1 & 2"). Refurbisher shall provide needed balance tooling. (*See Figure 13*). Depending on technique used to rigidize and align flexible coupling flanges, the larger bolt (Item 12) may or may not be installed at this time.

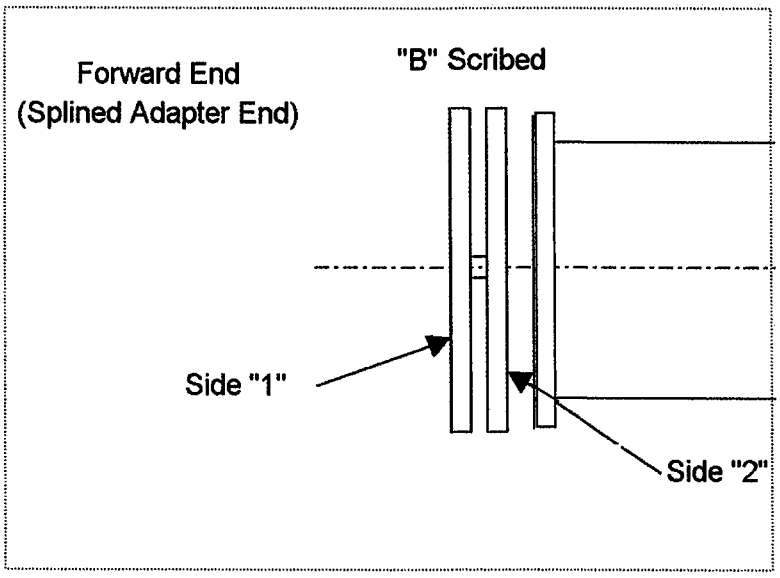


Figure 13 - Forward End Bolt Layout for Sub Assembly Balance

b. Add push-on nuts (Items 6 and 14 – See Table 3) onto the bolts to keep them in place (*See Figures 14 and 15*), ensuring that the D-headed part of the bolt is rotated into the correct position. All the bolts will sit at the same height, so if one appears shorter it is probably not seated. Note, a 7/16" twelve point deep well socket works well for getting the push-on nuts into place.

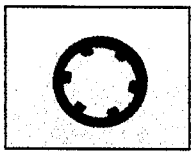


Figure 14 - Small Push-On Nuts

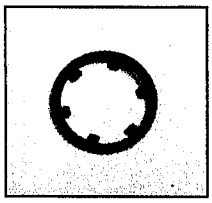


Figure 15 - Large Push-On Nuts

c. The refurbisher shall provide means to rigidize and align the diaphragm flanges without disturbing resulting balance. This step is to adjust the subassembly so that it is aligned, as it would be when installed in the turbine.

d. Lay forward flexible coupling (Item 2) down on side "2" supporting it at the center so that bolts do not get pushed back by the weight of the coupling. Verify side "1" is facing up and there is a slight pre-load between the diaphragms resulting from the rigidizing method identified in section "c" above.

e. Slowly lower forward adapter (Item 1) down onto side "1" of the flexible coupling ensuring the match marks are lined up. Care should be taken not to push the retained bolts back into the flexible coupling.

f. Slowly lower the forward anti-deflector ring (Item 3) down onto the flexible coupling - forward adapter assembly. Care should be taken not to push any of the bolts back into the flexible coupling. Aligning the anti-deflector ring may require light blows from a soft hammer.

Note: The Anti-deflector ring will not sit all the way down flush to the forward adapter until the nuts are installed and pilot is engaged.

g. Install flat washers (Items 7 and 15) onto each of the bolts on side "1".

h. Start the self-locking nuts (Items 10 and 16 – See Table 3) onto each bolt. Using a crisscrossing pattern begin to draw the forward anti-deflector ring (Item 3) onto the forward adapter (Item 1). Depending on technique used to rigidize and align flexible coupling flanges, the larger self-locking nut (Item 16) may or may not be installed at this time.

Note: This will require the force from nearly every nut in order to draw the ring on.

i. Using a crisscross method, torque each of the self-locking nuts (Items 10 and 16 – See Table 3) on side "1" to 350-400 in-lbs.

j. Use the two plane method to balance the subassembly within 12 gram-in (.4233 oz-in) of static balance. Verify that the single plane balance tolerance was met in order to be customer compliant. All balance tooling and proposed balance procedures shall be provided by the refurbisher and approved by customer prior to balancing. Note weight removal locations. (*See Figure 16*)

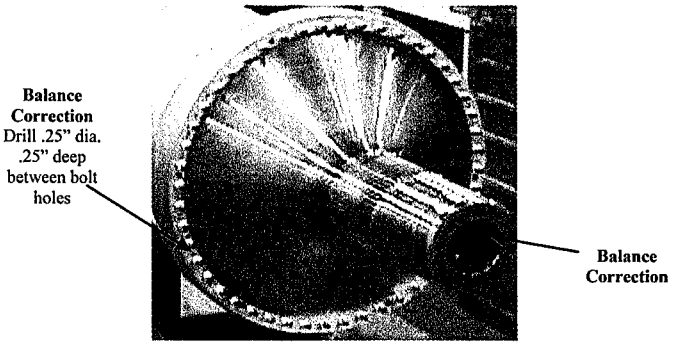


Figure 16 - Weight Removal Location for Forward Sub Assembly Balance

E.4 Aft End Sub Assembly for Balance

a. Install bolts (Items 4, 5, 12, 13) into aft flexible coupling (Item 25) using the installation procedure from section E.2. Note the flex coupling is marked with an ink marker (Side "1 & 2"). (*See Figure 17*). Depending on technique used to rigidize and align flexible coupling flanges, the larger bolts (Items 12 or 13) may or may not be installed at this time.

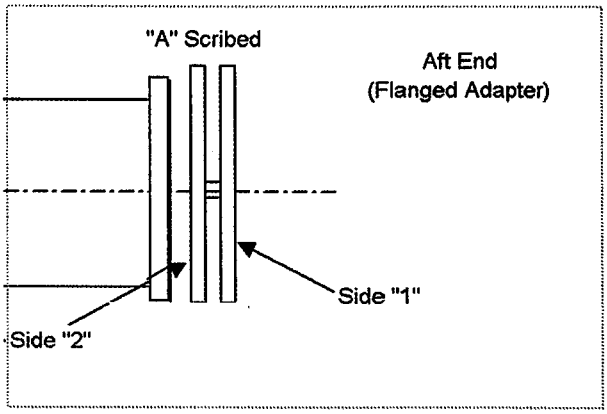


Figure 17 - Aft End Bolt Layout for Sub Assembly Balance

b. Add push-on nuts (Items 6 and 14 – See Table 3) onto the bolts to keep them in place (*See Figures 14 and 15),* ensuring that the D-headed part of the bolt is rotated into the correct position. All the bolts will sit the same height, so if one appears shorter it is probably not seated. Note, a 7/16" twelve point deep well socket works well for getting the push-on nuts into place.

c. The refurbisher shall provide means to rigidize and align the diaphragm flanges without disturbing resulting balance. This step is to adjust the subassembly so that it is aligned, as it would be when installed in the turbine.

d. The assembly can be placed onto side "2" of the flexible coupling. Care should be taken not to push any of the bolts back into the flexible coupling, or to unseat any of the bolts. Verify they are all the same length.

e. Slowly lower aft adapter (Item 26) down on to side "1" of the aft flexible coupling (Item 25) ensuring the match marks are lined up. Care should be taken not to push the retained bolts back into the flexible coupling.

f. Slowly lower the aft anti-deflector ring (Item 27) down onto the flexible coupling –aft adapter assembly. Care should be taken not to push any of the bolts back into the flexible coupling. The anti-deflector ring may require light blows from a soft hammer to align.

Note: The Anti-deflector ring will not sit all the way down flush to the forward adapter until the nuts are installed and pilot is engaged.

g. Install flat washers (Items 7, 8 , 15) onto each of the bolts on side "1". Verify that all bolts have the same length sticking out of the anti-deflection ring, this is a double check that they are still seated-Repeat if necessary.

h. Start the self-locking nuts (Items 10 and 16 – See Table 3) onto each bolt. Using a crisscrossing pattern begin to draw the aft anti-deflector ring (Item 27) onto the aft adapter (Item 26). Depending on technique used to rigidize and align flexible coupling flanges, the larger self-locking nut (Item 16) may or may not be installed at this time.

Note: This will require the force from nearly every nut in order to draw the ring on.

i. Using a crisscross method, torque each of the self-locking nuts on side "1" to 350-400 in-lbs.

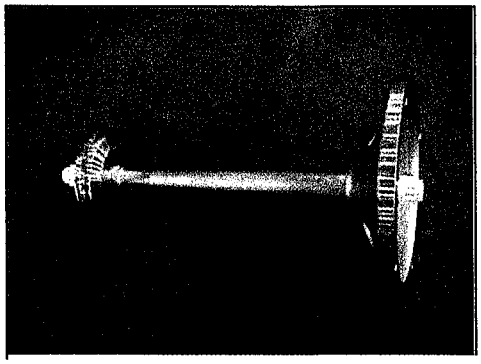


Figure 18 – Damper Piston Assembly

j. Install damper piston assembly (Item 36) (*See Figure 18*) into aft adapter (Item 26) aligning match-marks. (*See Figure 19*) Install socket head cap screws (Item 37) and torque to 55-70 in-lbs.

Note: The damper piston assembly may require a few light blows at the shaft center from a soft hammer to seat, until the pilot cap screws engage.

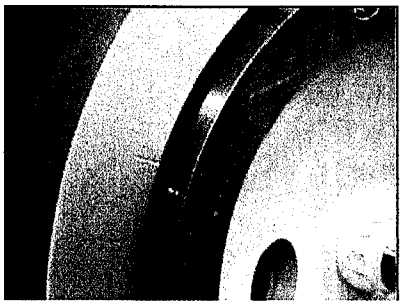


Figure 19 – Match-Mark Alignment of Damper Assembly and Aft Adapter

k. Using the two plane method, balance the subassembly within 20 gram-in (.7055 oz-in) of static balance. Verify that the single plane balance tolerance was met in order to be customer compliant. All balance tooling and proposed balance procedures shall be provided by the refurbisher and approved by customer prior to balancing. Note weight material removal locations. (*See figure 20*)

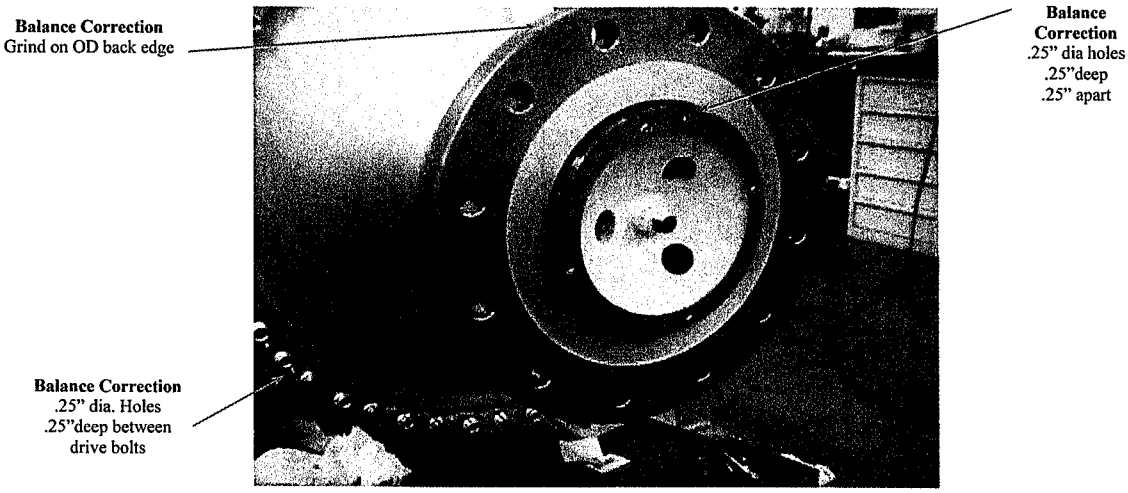


Figure 20 - Weight Removal Location for Forward Sub Assembly Balance

E.5 Final Assembly

E.5.1 Forward End Assembly

a. Install all D-headed bolts (Items 4 and 12) using the installation method in section E.2.2. (*See Figure 21*)

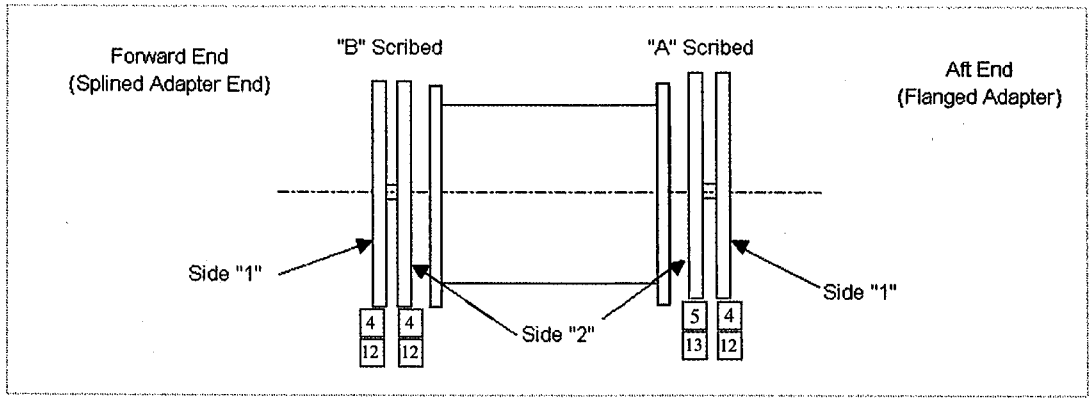


Figure 21 - Final Assembly Bolt Layout

b. Aligning match-marks, install forward flexible coupling (Item 2) onto "B" side of distance piece (Item 18) with side "2" of flexible coupling toward distance piece. Use a few washers and nuts to temporarily secure flexible coupling to the distance piece.

c. Add all flat washers, self-locking nuts, balance plates and balance washers (Items 7, 8, 9, 10, 11, 15, 16) to the side "2" bolts. Nuts can then be tightened using a crisscross method to a torque of 350-400 in-lbs.

d. Install forward adapter (Item 1) onto flexible coupling side "1", aligning "B" match-marks. Care should be taken not to push any bolts back into the flexible coupling, continue to support forward adapter. Verify that all bolts have the same length protruding out of the hub interface before proceeding.

e. Install the forward anti-deflection ring (Item 3) over the forward adapter (Item 1) so that the match-marks are aligned, again being sure not to push any of the D-headed bolts back into the diaphragm pack. If any of the bolts get pushed back, this step must be repeated.

Note: The Anti deflector ring will not pull up entirely until the nuts are tightened.

f. Install flat washers (Items 7, 8, 15) onto each of the bolts. Verify that all bolts have the same length sticking out of the anti-deflector ring, this is a double check that they are still seated-Repeat if necessary.

g. Start each self-locking nut (Items 10 and 16 – See Table 3) onto each bolt. Using a crisscrossing pattern begin to draw the forward anti-deflector ring (Item 3) onto the forward adapter (Item 1). Note, this will require the force from nearly every nut in order to draw the ring on. Next, using a crisscross method, torque each of the forty-eight nuts to 350-400 in-lbs. (*See figure 22*)

h. Install weight-matched assembly balance tooling (to be weight balanced and equally spaced). This is to rigidize and align the coupling assembly. All balance tooling and proposed balance procedures shall be provided by the refurbisher and approved by customer prior to balancing.

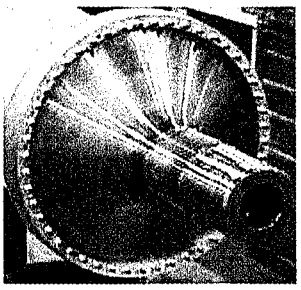


Figure 22 - Assembled Forward End

E.5.2 Aft End Assembly

a. Install all D-headed bolts (Items 4, 12, 5, 13) using the installation method in section E.2.2. (*See Figure 21*)

b. Add push-on nuts (Items 6 and 14 – See Table 3) (*See Figures 14 and 15*) onto all bolts. Ensure that the D-headed part of the bolt is rotated into the correct position. All the bolts will sit the same height, so if one appears shorter it is probably not seated. Note, a 7/16" twelve point deep well socket works well for pushing the retaining washers into place.

c. Install damper diaphragm (Item 24) onto side "2" of diaphragm "A", aligning match-marks. Care should be taken not to push bolts back into flexible coupling.

d. Install aft end diaphragm-damper assembly onto distance piece side "A", aligning match-marks. Care should be taken not to push bolts back into diaphragm. Add a few washers and nuts to temporarily secure. (*See Figure 23*)

Caution: Be sure to support distance piece (Item 18) at both ends, it may become top heavy.

e. Install aft adapter end to "A" side of distance piece, aligning match-marks. Be sure not to unseat any of the D-headed bolts. Keep weight of Aft end supported.

f. Install the aft anti-deflector ring (Item 27) over the aft adapter (Item 26) so that the match-marks are aligned, again being sure not to push any of the D-headed bolts back into the diaphragm pack. If any of the bolts get pushed back, this step must be repeated.

Note: The Anti-deflection ring will not pull up entirely until the nuts are tightened.

g. Install flat washers (Items 7, 8, 15) onto each of the bolts. Verify that all bolts have the same length sticking out of the anti-deflector ring, this is a double check that they are still seated. Repeat if necessary.

h. Start each self-locking nut (Items 10 and 16 – See Table 3) onto each bolt. Using a crisscrossing pattern begin to draw the anti-deflector ring (Item 27) onto the aft adapter (Item 26). Note this will require the force from nearly every nut in order to draw the ring on. Next, using a crisscross method, torque each of the forty-eight nuts to 350-400 in-lbs.

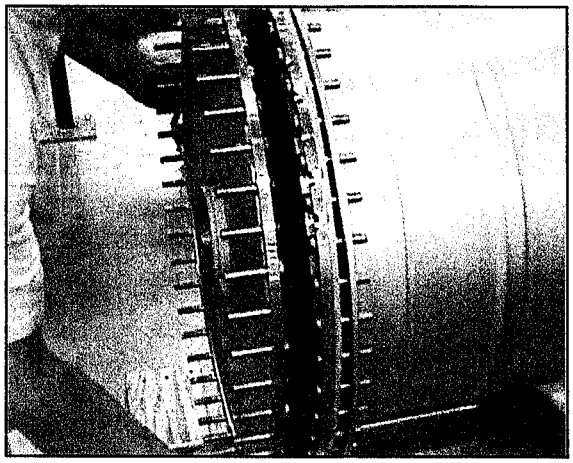


Figure 23 – Assembled Aft End

i. Install damper piston assembly (Item 36) (*See Figure 18*) into aft adapter, aligning match-marks. Install Socket head cap screws (Item 37) and torque to 55-70 in-lbs.

Note: The damper assembly may require a few light blows at the shaft center from a soft hammer to ensure pilot cap screws engage.

j. Install weight-matched assembly balance tooling to rigidize and align the coupling assembly. All balance tooling and proposed balance procedures shall be provided by the refurbisher and approved by customer prior to balancing.

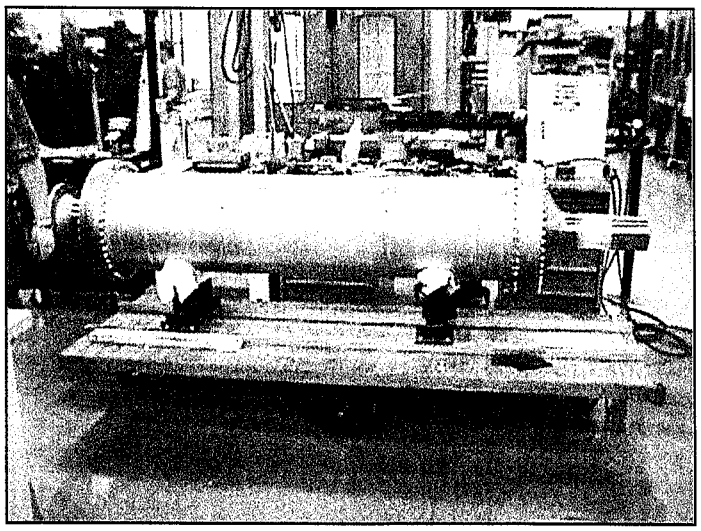


Figure 24 - Assembled Coupling Ready for Assembly Balance

E.6 Final Assembly Balance

a. Before the coupling can be assembly balanced, it must be indicated to represent the actual installation between the turbine and gearbox. Ensure that both ends are indicated in. (*See Figures 25, 26, and 27*)

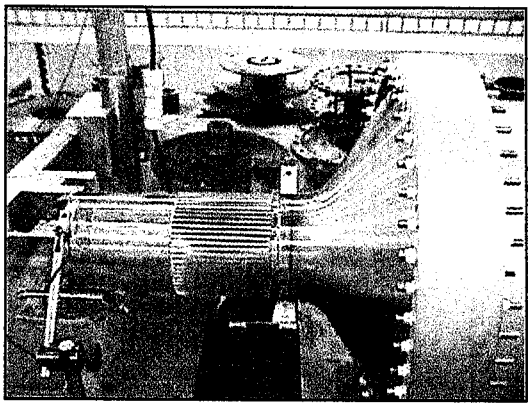


Figure 25 - Indicating Forward End

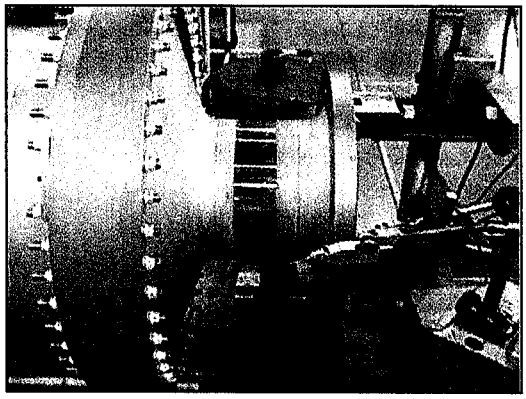


Figure 26 - Indicating Aft End

b. Be sure coupling is indicated to the requirements (*See Figure 27*). All balance tooling and proposed balance procedures shall be provided by refurbisher and approved by customer prior to balancing.

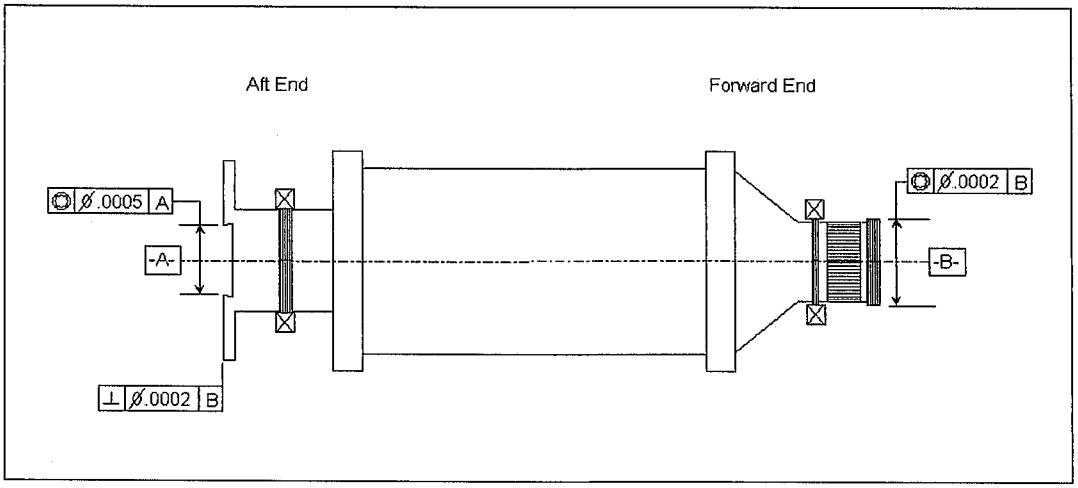


Figure 27 - Assembly Balance - Indicating Requirements

c. After the coupling is indicated, it is then ready for assembly balance. The assembly balance requirement is .35 in-oz per end. Washers are added on the spacer side of the

coupling only as compensating weights, then nuts are re-torqued. This procedure is repeated until the balance requirement is met.

d. After assembly balance is complete and the balance tooling is removed, coupling is reassembled with all components reinstalled in the location they were in during balancing. Refurbisher shall explain this procedure and have it approved by customer before implementing.

e. The refurbished coupling shall be shipped completely assembled in a suitable packaging crate or container. Coupling shall be shipped to the following address:

Ship System Engineering Station, Carderock Division
Naval Surface Warfare Center
Philadelphia Naval Business Center, Building 1000
5001 South Broad Street
Philadelphia, PA 19112-1403

Tables

Item No.	Description	Quantity
1	Adapter, Forward	1
2	Coupling, Flexible	1
3	Ring, Anti-Deflector	1
4	Bolt, Slabbed Hd, 0.375-24, 1.85 in Lg	135
5	Bolt, Slabbed Hd, 0.375-24, 1.85 in Lg	45
6	Nut, Push-On *	180/ALT
7	Washer, Flat *	180
8	Washer, Flat	AR
9	Plate, Balance	AR
10	Nut, Self-Locking *	180
11	Washer, Balance	AR
12	Bolt, Slabbed Hd, 0.4375-20, 1.85 in Lg	9
13	Bolt, Slabbed Hd, 0.4375-20, 1.85 in Lg	3
14	Nut, Push-On, Balance *	12/ALT
15	Washer, Flat	12
16	Nut, Self-Locking, Dbl Hex, 0.4375-20 *	12/ALT
17	Shaft Assembly	1/ALT
18	Piece, Distance (Extruded Type)	1
19	Ring, Damper	2
20	Bolt, Shoulder, Dbl Hex Hd, AMS 5731, 0.250-28, 0.562 Lg	6
21	Washer *	AR
22	Washer, Flat and Slotted *	6
23	Nut, Self-Locking, Dbl Hex Hd	ALT
24	Diaphragm, Damper	1
25	Coupling, Flexible	1
26	Adapter, Aft	1
27	Ring, Anti-Deflector	1
28	Ring, Retainer	1
29	Damper, Cylinder	1
30	Plug Assy	1
31	Ring, Retaining, Internal, 2.562 in Dia.	1
32	Ring, Damper, Spacer	1
33	Plug, Threaded Damper	1
34	Bolt, Machine, Slab Hd, AMS 5731, 0.250-28, 1.10 in	3
35	Nut, Self-Locking, Dbl Hex Hd	3/ALT
36	Piston Assy, Damper	1
37	Screw, Cap, Socket Hd, 0.250-28, 0.500 in Lg	4
38	Adapter, Piston Assy Damper	1/ALT
39/44	Nut, Self-Locking, Dbl Hex Hd *	2/ALT
40	Rod, Piston Assy Damper	1
41	Ring, Piston Assy Damper Piston	1
42	Ring, Piston Assy Damper Spacer	1
43	Plate, Piston Assy Damper Locking	2

Table 1- High Speed Coupling Shaft Parts List
* Indicates Items that must be replaced with new parts during refurbishment.

Observed Condition/Discrepancy	Max Serviceable Limits	Max Repairable Limits	Corrective Action
1. Assembly (Unless otherwise specified) for:			
a. Cracks	Not serviceable	Not repairable	Replace shaft
b. Nicks, scratches (except on distance piece)	Not serviceable	Not repairable	Replace shaft
c. Dents	Not serviceable	Not repairable	Replace shaft
d. Missing Sermetel finish except on forward adapter, flexible couplings and anti-deflector ring	Any amount provided no parent metal is exposed	Any amount	Touch up with Sermetel 196 coating (Teleflex Inc., North Wales, Pa.)
e. Dirty	Serviceable	Any amount	Clean as required
f. Loose fasteners (at flange joints only)	Not serviceable	Any amount	Retorque fasteners
g. Internally contaminated with lube oil	Not serviceable	Any amount	Clean
2. Distance Piece for:			
a. Nicks, scratches	Not serviceable	Any amount 0.005 inch deep, 12 inches long in parent metal	Blend, then touch up with Sermetel 196 coating (Teleflex, Inc., North Wales, Pa.)
3. Anti-deflector rings for:			
a. Cracks	Not serviceable		
b. Nicks, scratches	Any amount 0.005 inch deep provided no corrosion		
4. Forward Flex Flange Discs for:			
a. Damaged or sheared bolts	Not serviceable	Not repairable	Replace as required
b. Webs for scratches	Not serviceable	Not repairable	Replace shaft
c. Cracks	Not serviceable	Not repairable	Replace shaft

Table 2 - High Speed Coupling Shaft Inspection

Part No.	Description	Supplier	Qty	Material	Appx Dimensions
14	Large Push-On Nut (Retaining Washer)	Rotor Clip	12	Stainless Steel	TY-43
6	Small Push-On Nut (Retaining Washer)	Rotor Clip	180	Stainless Steel	TY-37
8	Large Flat Washer (Diaphragm Washer)	BOKER'S INC.	12+	301/302 Stainless Steel	0.750 OD, 0.475 ID
7	Small Flat Washer (Diaphragm Washer)	BOKER'S INC.	180+	301/302 Stainless Steel	0.630 OD, 0.385 ID
21	Small Washer for Damper Ring	BOKER'S INC.	6+	302/304 Stainless Steel annealed	0.472 OD, 0.248 ID
22	Large Washer for Damper Ring	BOKER'S INC.	6+	301/302 Stainless Steel Annealed	0.630 OD, 0.387 ID
16	Large Self-Locking Nuts For Diaphragm	Aerospace Products	12	PN: NAS1805-7P Stainless Steel A286; Silver plated	.4375-20 thread
10	Small Self-Locking Nuts For Diaphragm	Aerospace Products	180	PN: NAS1805-6P Stainless Steel A286; Silver plated	.3750-24 thread

Table 3 - Replacement Parts